SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD



dsPICPRO2 User's Manual

with on board USB 2.0 programmer

With useful implemented peripherals, plentiful practical code examples and a broad set of additional add-on boards (ADC potentiometer, two RS-232, RS485, Compact Flash, MMC/SD, PS/2 keyboard, CAN etc.), MikroElektronika development boards make fast and reliable tools that can satisfy the needs of experienced engineers and beginners alike.

Software and Hardware solutions for Embedded World





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CONNECTING THE SYSTEM

The development system box contains a development system, CD, USB cable and serial cable.

Step no.1 The first thing to do is to take the system out of a box. Unpack the USB cable and connect it to the PC. Please use USB ports from the back of the PC, with direct contact to the motherboard.

Step no.2 Connect the USB cable to the dsPICPRO2 board.

Step no.3 The PC will start the procedure for installing the USB driver for the on-board USB 2.0 programmer. Follow the procedure from the document ' *Installing Driver for USB programmer*' and install the USB driver.

Step no.4 Copy dsPICFLASH.exe file to the folder of your choice. You can find this file in the dsPICFLASH folder on the CD.

Step no.5 Run and use dsPICFLASH.exe as explained in the document 'ds*PICflash programmer*'.

After these 5 steps, your dsPICPRO2 is installed and ready for use. You should try to read a program from the chip or to load an example.

Loading an example:

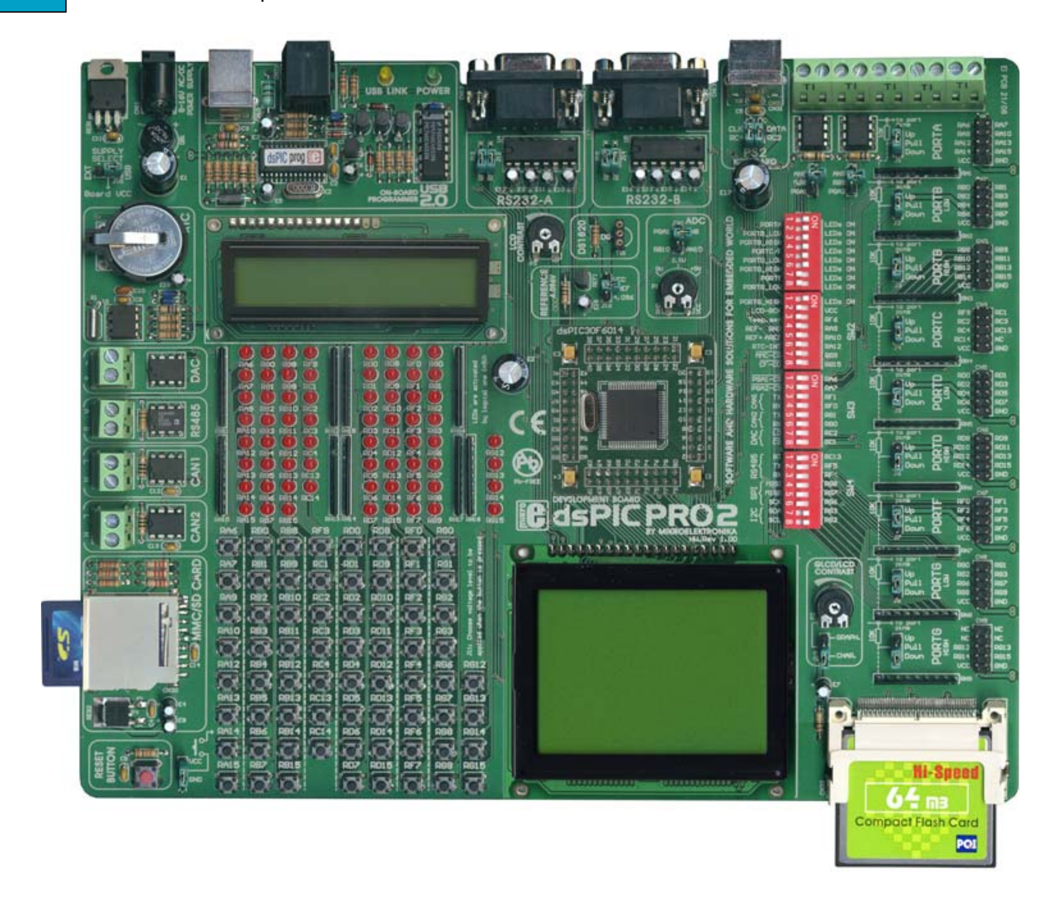
1) Install one of our compilers mikroC for dsPIC, mikroPascal for dsPIC or mikroBasic for dsPIC.
2) Open the compiler window and from the Project menu choose Open Project. In the compiler's Examples folder find the dsPIC30F6014 subfolder and open some project file .
3) Build an example (Ctrl+F9) and write .hex file to MCU (F11)

INTRODUCTION

The dsPICPRO2 development system is a full-featured development board for Microchip dsPIC microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of dsPIC microcontrollers. It allows dsPIC microcontrollers to be interfaced with external circuits and a broad range of peripheral devices, allowing the user to concentrate on software development.

Figure 1 illustrates the development board. On a silkscreen, there are identification marks beside each component. These marks describe connections to the microcontroller, operation modes, and provide some useful notes. The need for additional schematics is minimized as all the information is printed on the board.

Figure 1. dsPICPRO2 development board



SWITCHES

The dsPICPRO2 development board features many peripherial devices. In order to enable these devices before programming, you need to check if appropriate jumpers or switches have been properly set.

Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts.

The first switch, **SW1,** is used to enable LEDs connected to ports RA, RB_L, RB_H, RC/RF, RD_L, RD_H, RF and RG_L. For example, if switch RB_L is OFF, all RB lower LED's will be turned off.

First switch on **SW2** is used for port RG_H. The rest of the switch **SW2, SW3** and **SW4** are used to enable connections between various peripheral devices and microcontroller pins.

For example, **SW2, SW3** and **SW4**, enable connection between the microcontroller pins and temperature sensor, programmable gain amplifier (PGA), MMC/SD Card, Compact Flash Card, real time clock (RTC), Digital-to-Analogue Converter (DAC), CAN, CAN-SPI, RS-485 communication etc.

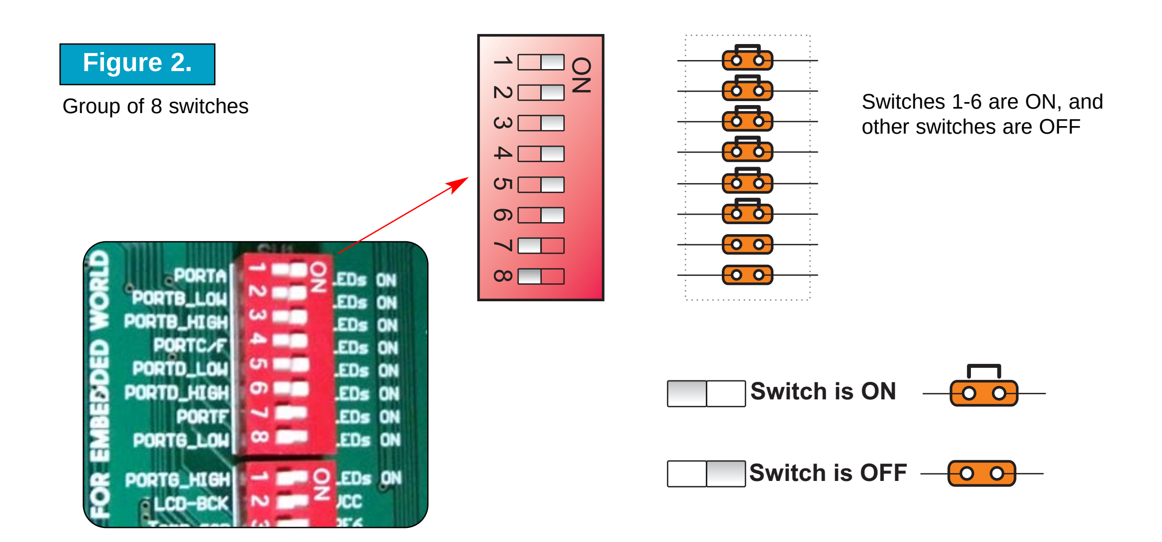


Figure 2.
Group of 8 switches

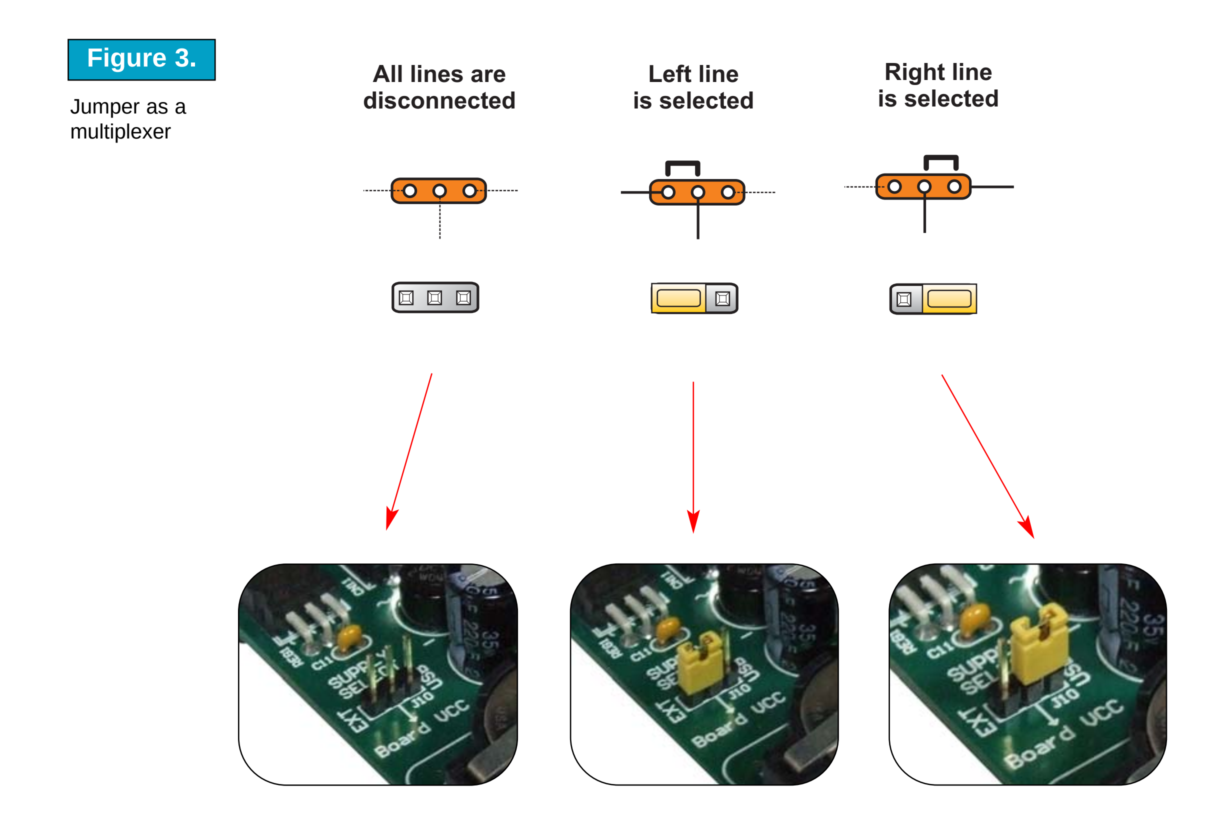
JUMPERS

Jumpers, like switches, can break or establish a connection between two points. Beneath the plastic cover of the jumper is a metal contact, which makes a connection when the jumper is placed between two disconnected pins.

Jumpers are used as a selector between two possible connections using a three pin connector. As illustrated in Fig. 3, middle connector can be connected to the left or right pin, depending on the jumper's position.

Figure 3.

Jumper as a multiplexer



MCU CARD

The dsPICPRO2 development board have a 80-pin MCU Card as shown on the following picture. The 64-pin MCUs on the 80-pin MCU Cards are supported by the dsPICPRO2 development board too.

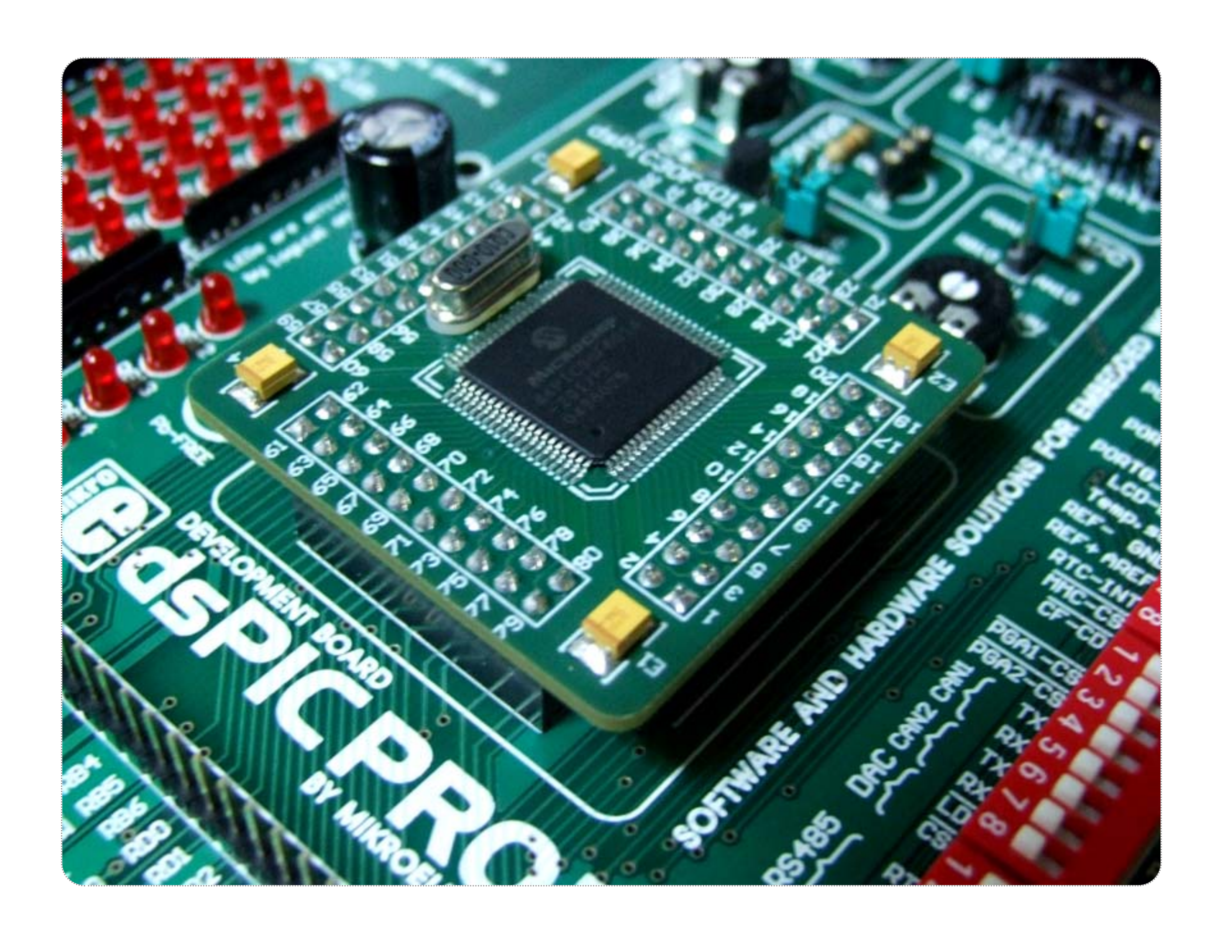
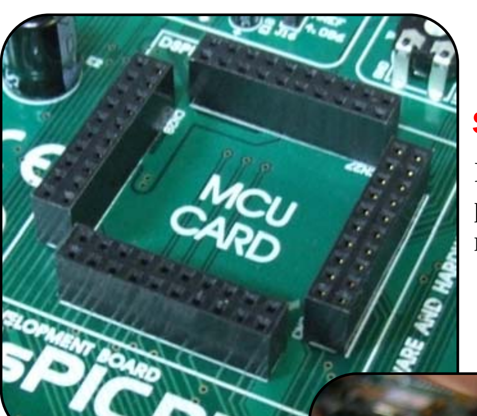


Figure 4. MCU Card

When you are placing MCU Card on the dsPICPRO2 MCU socket you must follow these steps:

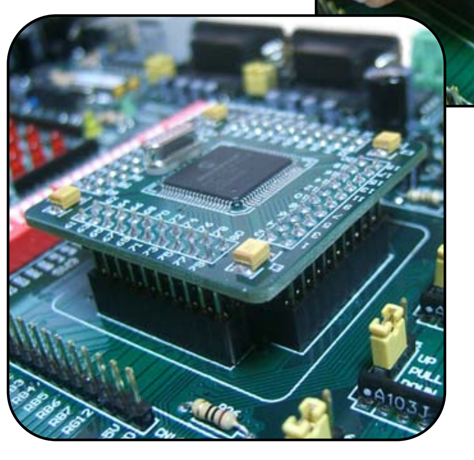


Step no.1

If there is already MCU Card placed on dsPICPRO2, you must remove it by slowly pulling it up.

Step no.2

Label on the MCU Card must be at the upper-left corner as it is drawn on the dsPICPRO2 board.



Step no.3

When MCU Card is on the place, push it down by applying the pressure on all edges at the same time.

The microcontroller's pins are routed to various peripherials as illustrated in Fig.5. All ports have direct connections to Direct Port Access connectors. Such connectors are typically used for connecting external peripherials to the board, or for providing useful points for connecting digital logic probes.

All ports are connected to LEDs, push-button switches and pull-up/down resistors , which allow for easy digital pin state setting, monitoring and testing.

Some of the pins are connected to other peripherials such as the DS1820 temperature sensor, RS-232 communication, LCD, etc.

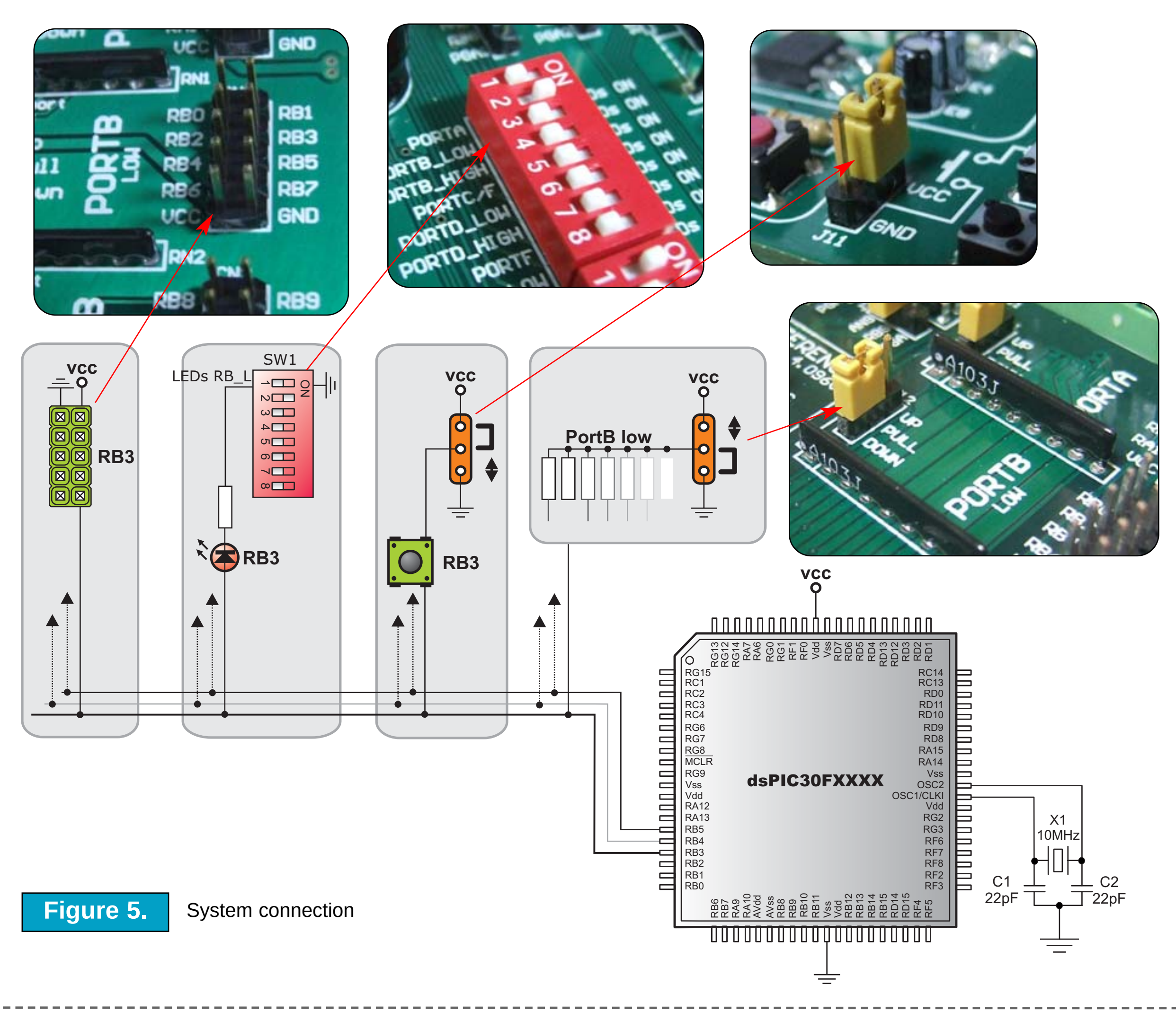


Figure 5. System connection

POWER SUPPLY

As a power supply source, users can select either a regulated supply from USB cable (default) or an external non-regulated power supply.

In case of the USB power supply, the system sholud be connected to a PC using the USB programming cable and jumper J10 should be set in the right position.

In case of an external power supply, the dsPICPRO2 board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 8V and 16 V, and jumper J10 should be set in the left position. In Fig. 6 you can see the USB (left) and power supply (right) connectors.

Figure 6. USB and power supply connectors

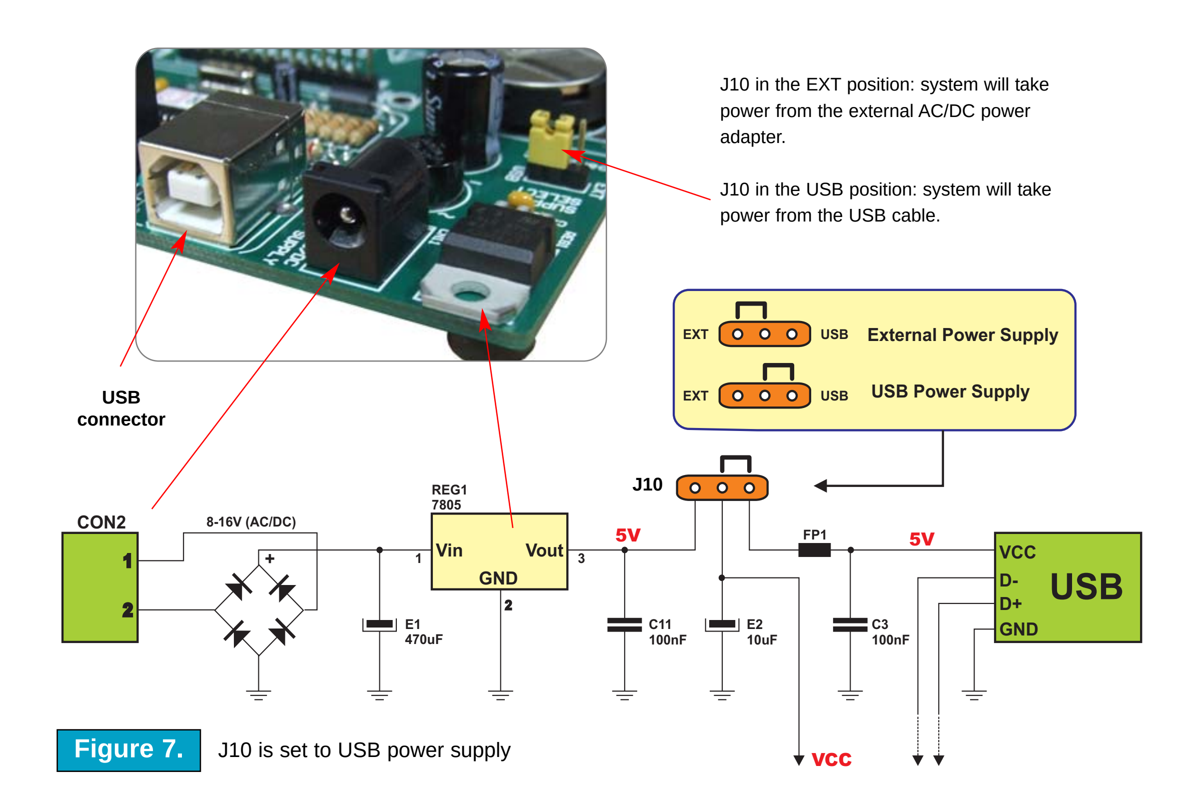


Figure 7. J10 is set to USB power supply

ON-BOARD USB PROGRAMMER

There is no need for the use of external equipment during programming, as the dsPICPRO2 development system has its own on-board USB programmer.

All you need to do is connect the system to a PC using the USB cable. Then, load your program into the microcontroller via the *dsPICFLASH2* programming software, which is supplied with the board.

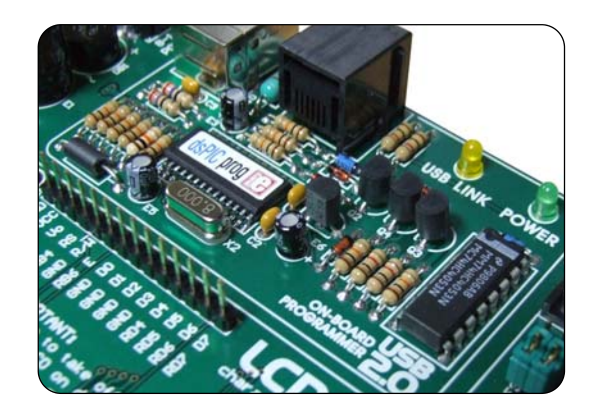


Figure 8. On-Board USB programmer

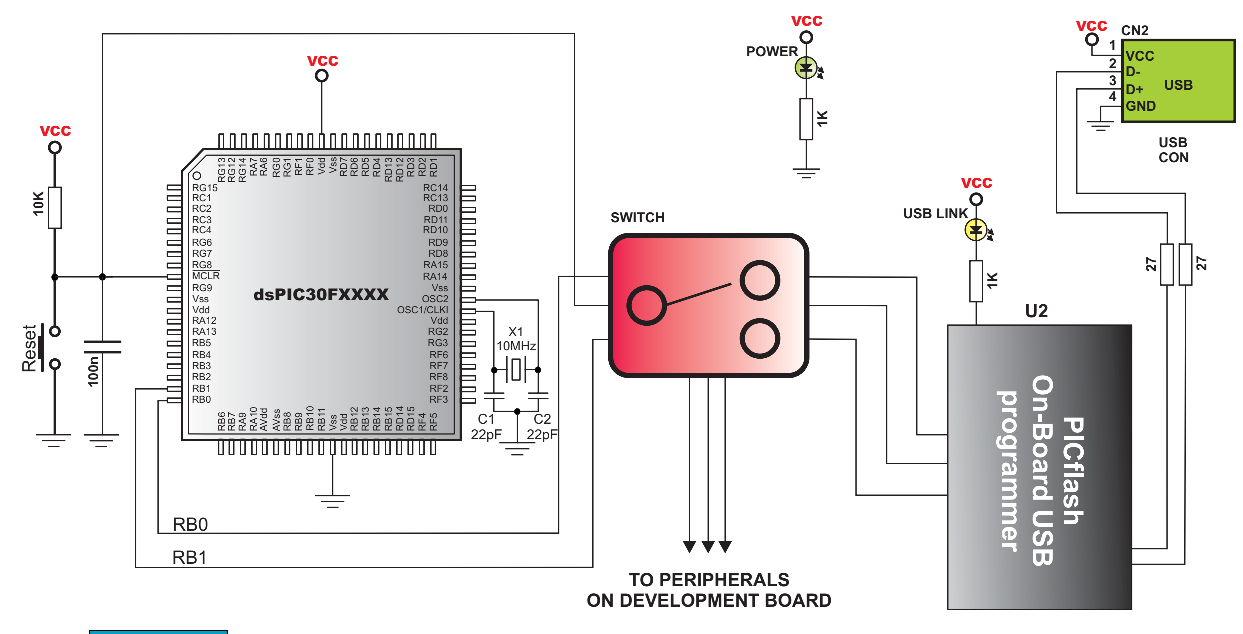


Figure 9. Switch scheme

LIGHT EMITTING DIODES

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. The dsPICPRO2 have 67 LEDs that are connected to the microcontroller's ports RA, RB low, RB high, RC/F, RD low, RD high, RF, RG low and RG high.

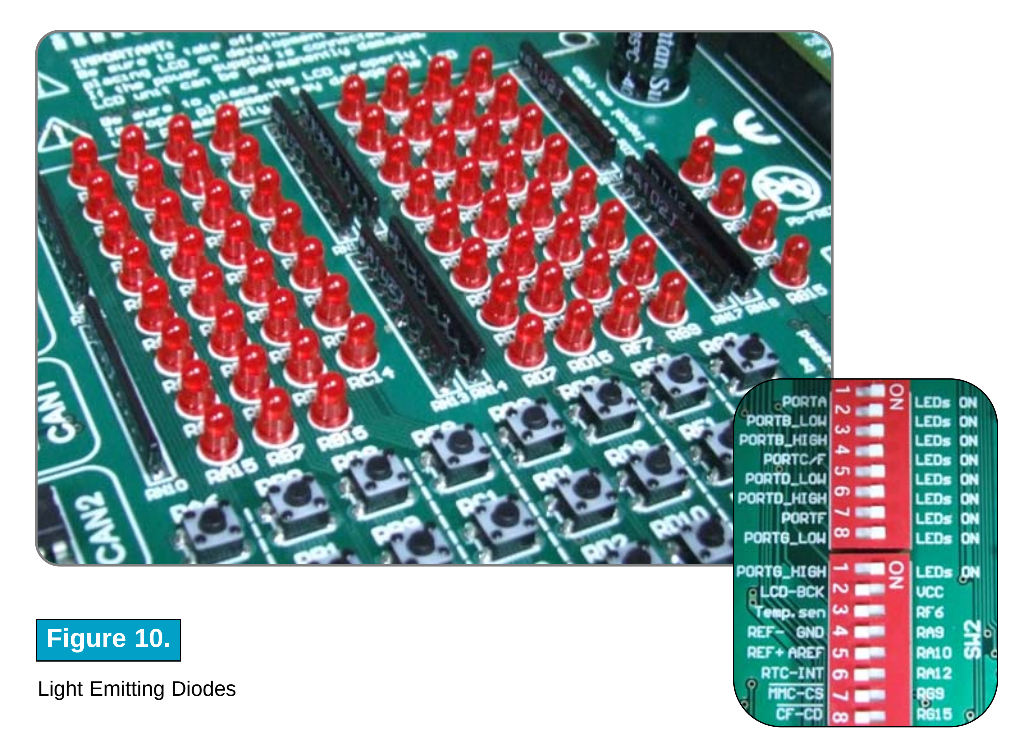


Figure 10.

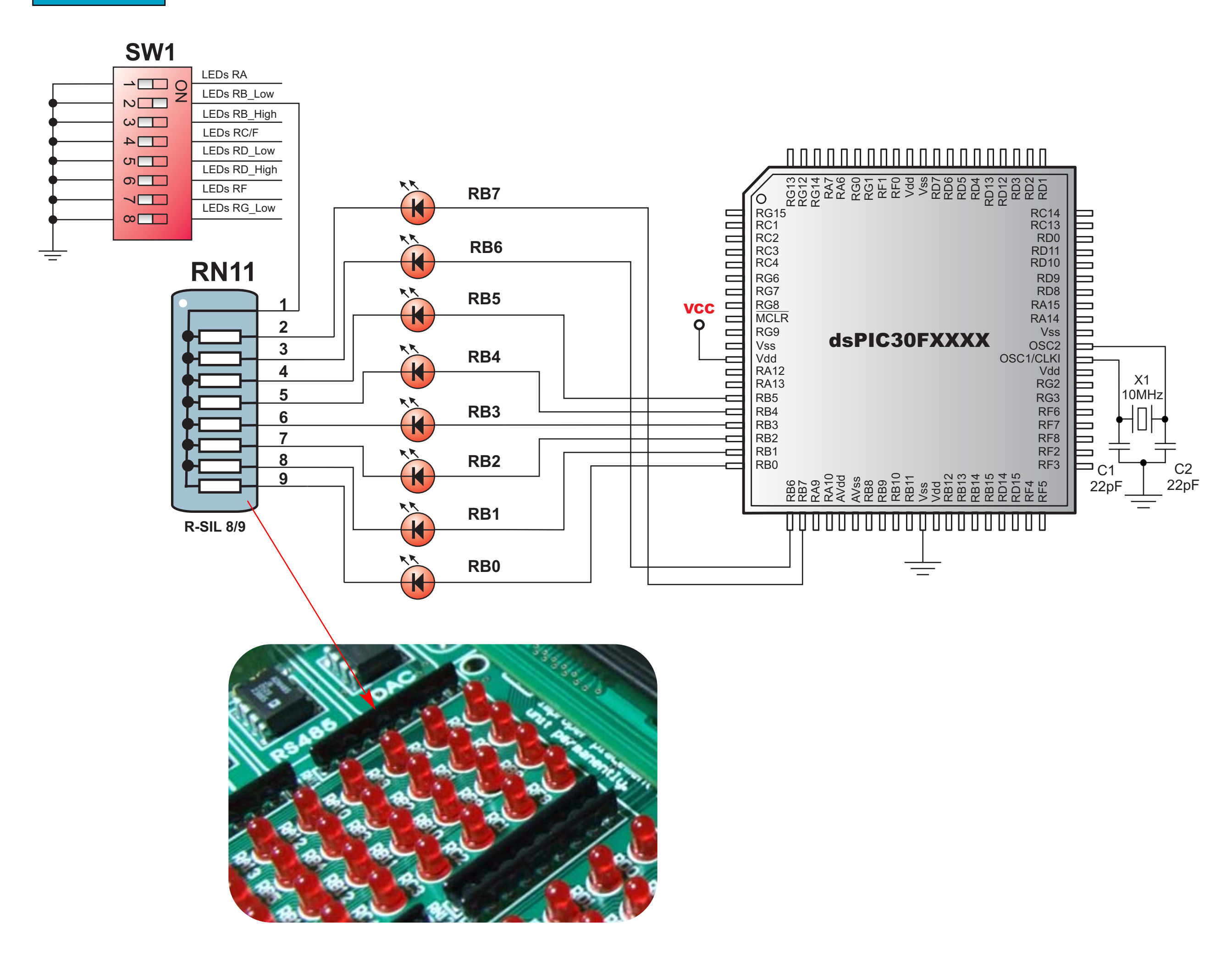
Light Emitting Diodes

Each group of eight LEDs can be enabled or disabled using switch SW1 and SW2 as shown in Fig. 10.

Fig. 11. on next page illustrates the connection of a LEDs to lower PortB of the microcontroller. A resistor is used in series with the LED to limit the LED's current. In this case the resistor's value is 1K.

All LEDs from one port are connected to a common point through these resistors, which can then be connected or disconnected to ground by the corresponding switch on SW1. The LEDs are enabled when connected to a ground and will display the state of the corresponding microcontroller pin; otherwise the LEDs will always be off, no matter what the pin state is, because no current can flow through it.

Figure 11. LED schematic

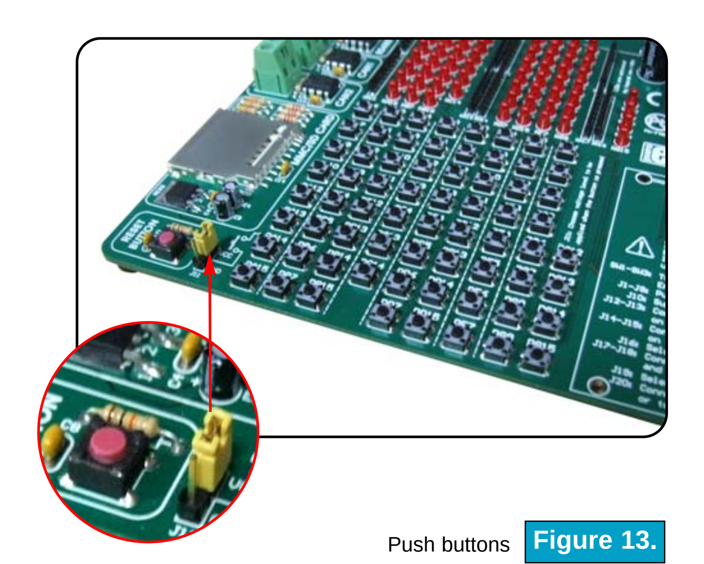


PUSH BUTTONS

The dsPICPRO2 has 67 push buttons, which can be used to provide digital inputs to the microcontroller's ports. There is also one push button that acts as a RESET (Figure 12).



Reset button **Figure 12.**



Push buttons **Figure 13.**

Jumper J11 (zoomed on the figure 13) determines whether a button press will bring logical zero or logical one to the appropriate pin.

When the button is not pressed the pin state is determined by the pull-up or pull-down port jumpers.

In Fig.14 is shown buttons, J11 and ports connection. In this example, the buttons are connected to +5V so the pull-down port resistors would be required.

Figure 14. Buttons, J11 and ports schematic

In the case of Fig. 15 the pull-up resistor pulls the microcontroller port pin to +5V when the button is not pressed. A button press causes the port pin to be connected to ground (J11 is in the lower position). Thus, only when the button is pressed will the microcontroller sense a logical zero; otherwise the pin state will always be logical one.

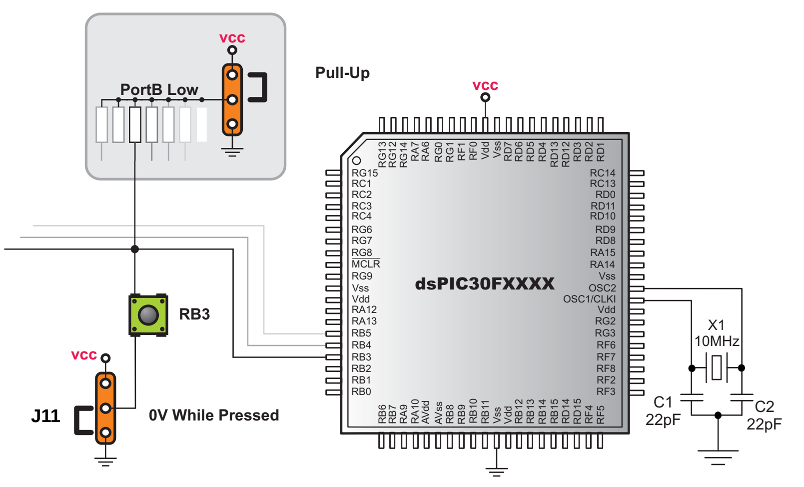


Figure 15. Single button with pull-up resistor

In the case of Fig. 16 the pull-down resistor pulls the microcontroller port pin to ground when the button is not pressed. A button press causes the port pin to be connected to +5V (J11 is in the upper position). Thus, only when the button is pressed will the microcontroller sense a logical one; otherwise the pin state will always be logical zero.

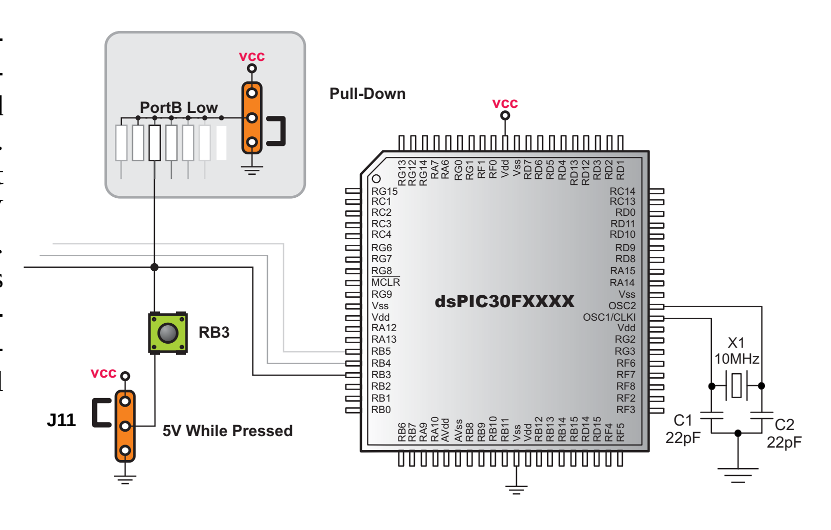


Figure 16. Single button with pull-down resistor

GRAPHIC LCD

The Graphic LCD (GLCD) allows advanced visual messages to be displayed. While a character LCD can display only alphanumeric characters, a GLCD can be used to display messages in the form of drawings and bitmaps. The most commonly used graphic LCD has a screen resolution of 128x64 pixels. When you add or remove GLCD be sure that the power supply is off.

Figure 17. GLCD



Before a GLCD is connected, the user needs to set jumper J19 (Fig. 18) to the upper position labeled as GRAPH. The GLCD's contrast can be adjusted using potentiometer P2.

Note : When used with GLCD the P2 potentiometer should start from the Left Position.

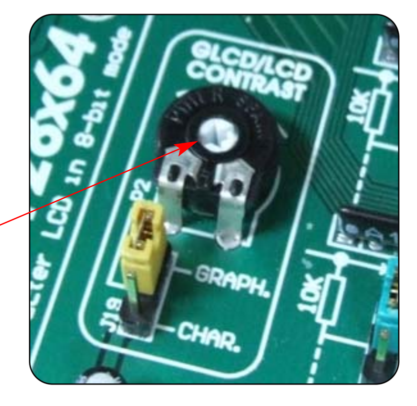
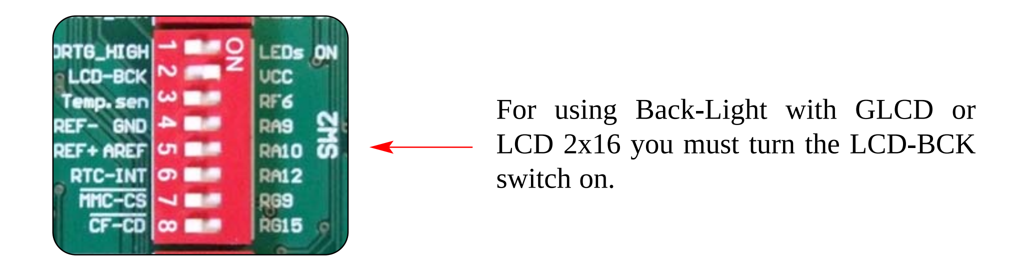


Figure 18. Potentimeter P2 and Jumper J19

In order to enable GLCD, the jumper J19 should be set to the position labeled as GRAPH.

Figure 19. GLCD schematic



For using Back-Light with GLCD or LCD 2x16 you must turn the LCD-BCK switch on.

Figure 20. LCD-BCK switch

GRAPHIC LCD 128X64

LCD 2X16 IN 4-BIT MODE

The standard character LCD is probably the most widely used data visualization component. Normally, it can display two lines of 16 alphanumeric characters, each made up of 5x7 pixels. The character LCD communicates with the microcontroller via a 4-bit or 8-bit data bus, each requiring the use of a different connector on the dsPICPRO2. For 4-bit data bus use, the LCD should be placed in the upper left of the board above the LEDs. The connection to the microcontroller is shown in Fig. 22 where there are only four data lines. It is important that the LCD is only added or removed from the dsPICPRO2 board when the power is off.

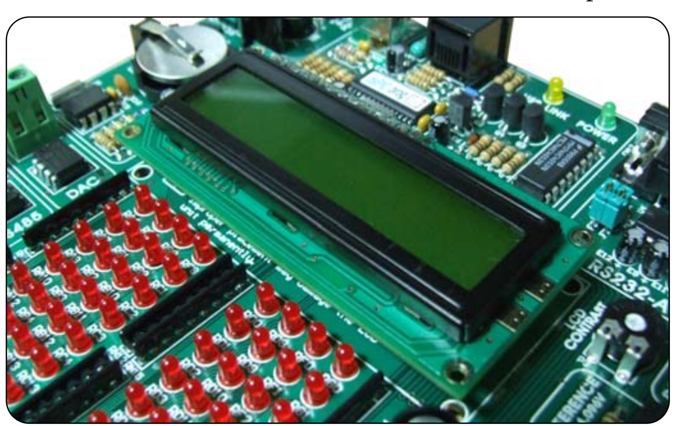


Figure 21.

LCD 2x16 in 4-bit mode

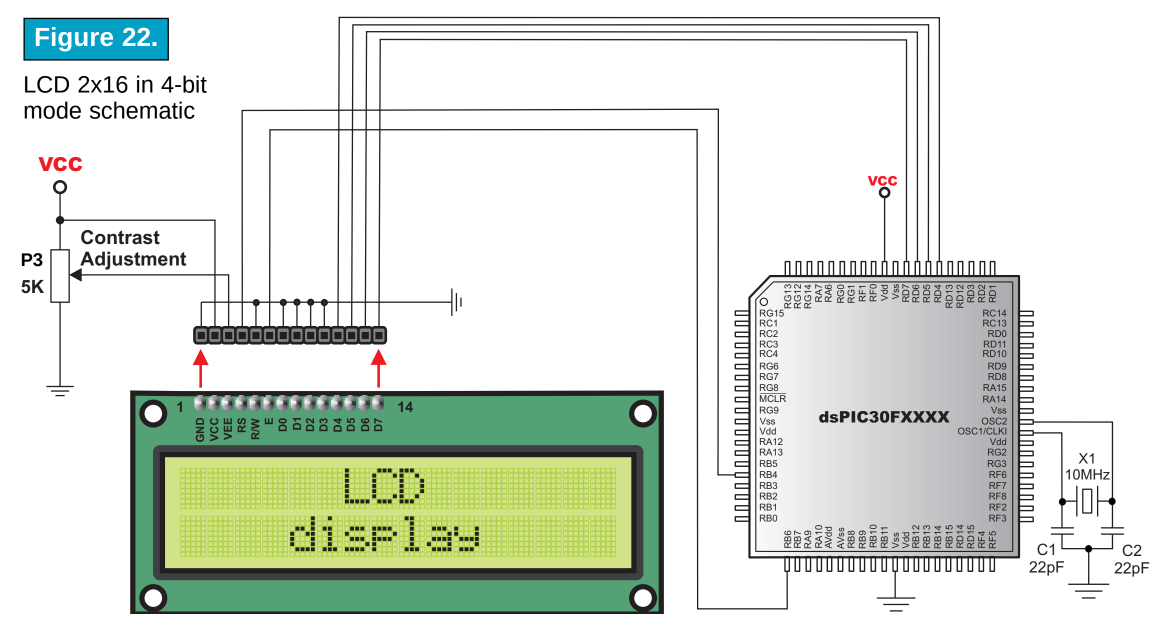


Figure 22.

LCD 2x16 in 4-bit mode schematic

LCD 2X16 IN 8-BIT MODE

When using a character LCD, it should be placed on the GLCD connector. Since GLCD connector has 20 pins and the character LCD has only 14 pins, special attention is required when placing the LCD. Otherwise the LCD can be permanently damaged. The LCD must be placed in the marked position with two free pins to the left and four free pins to the right. When you add or remove LCD be sure that the power supply is off.

Figure 23.

LCD 2x16



Before adding the LCD, set jumper J19 to the lower position, labeled as CHAR. The LCD's contrast can be adjusted using potentiometer P2.

Note : When used with LCD 2x16 the P2 potentiometer should start from the Right Position.

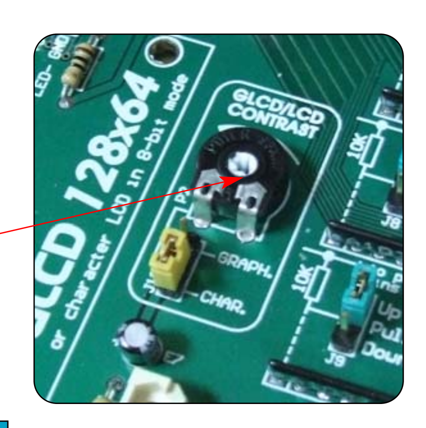


Figure 24. Potentimeter P2 and Jumper J19

LCD 2X16 IN 8 BIT MODE

In order to enable LCD, jumper J19 should be set to the position labeled as CHAR.

LCD 8-bit mode schematic **Figure 25.**

LCD8 contrast selected

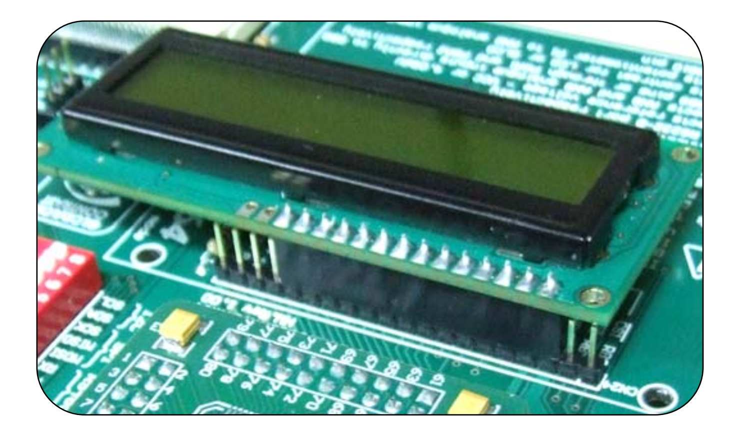
GLCD and LCD8 contrast deselected

GLCD contrast selected

Leave four pins to the right side free

Leave two pins to the left side free

Figure 26. LCD shown from back



RS-232 COMMUNICATION

RS-232 communication enables point-to-point data transfer. It is commonly used in data acquisition applications, for the transfer of data between the microcontroller and a PC. Since the voltage levels of a microcontroller and PC are not directly compatible with each other, a level transition buffer such as the MAX232 must be used.

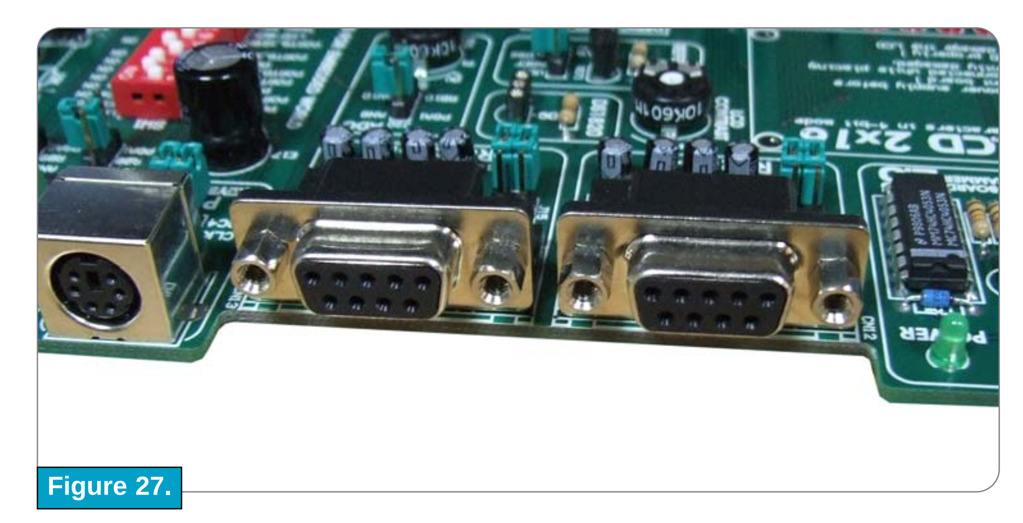


Figure 27.

RS232 connectors

dsPICPRO2 development board have two RS-232 communication devices, RS232-A and RS232-B. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through jumpers. First two jumpers J12 and J13 are used to connect Rx and Tx lines from microcontroller to RS232-A port, and second two jumpers J14 and J15 for connecting Rx and Tx lines to RS232-B.

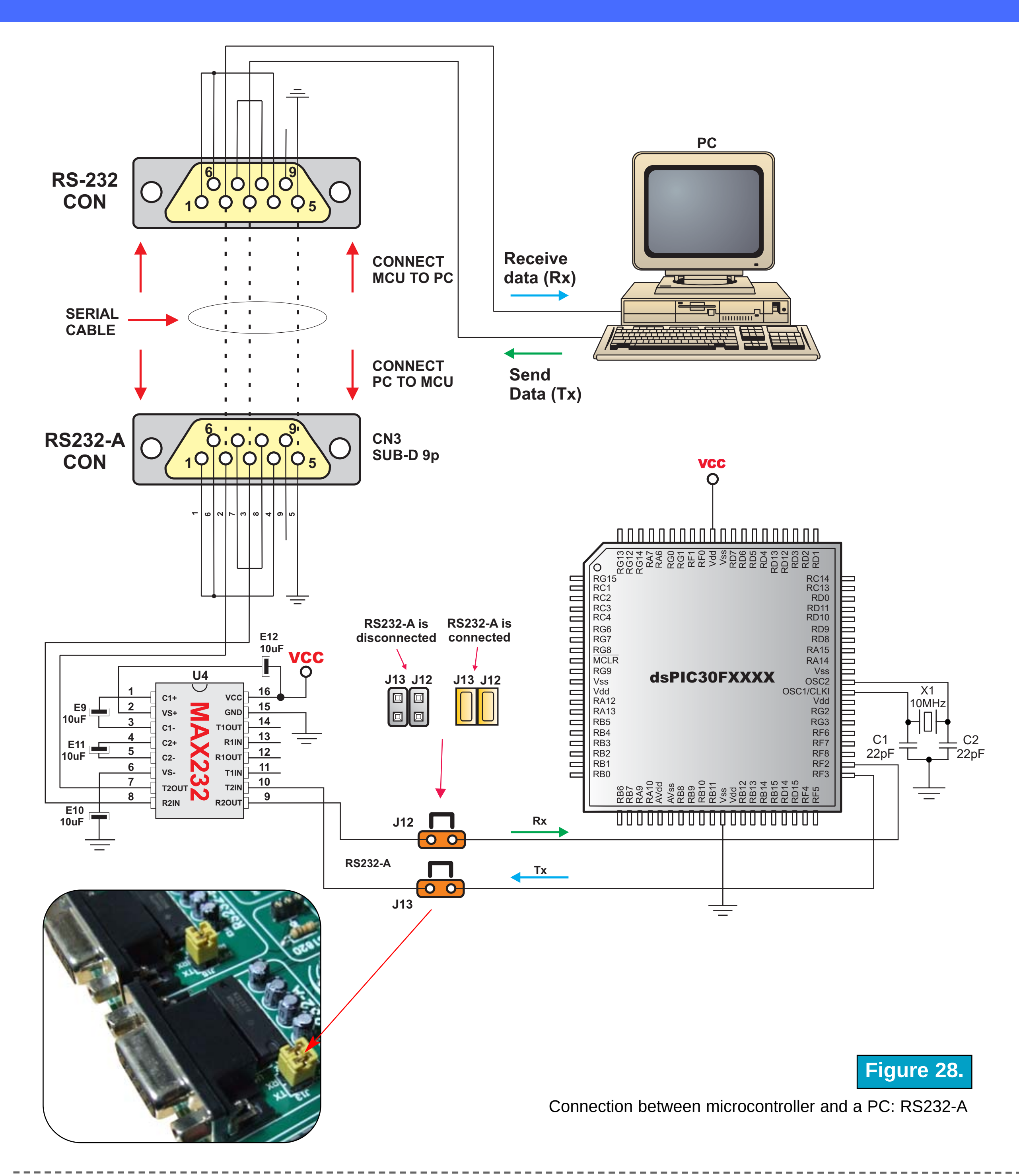


Figure 28.

Connection between microcontroller and a PC: RS232-A

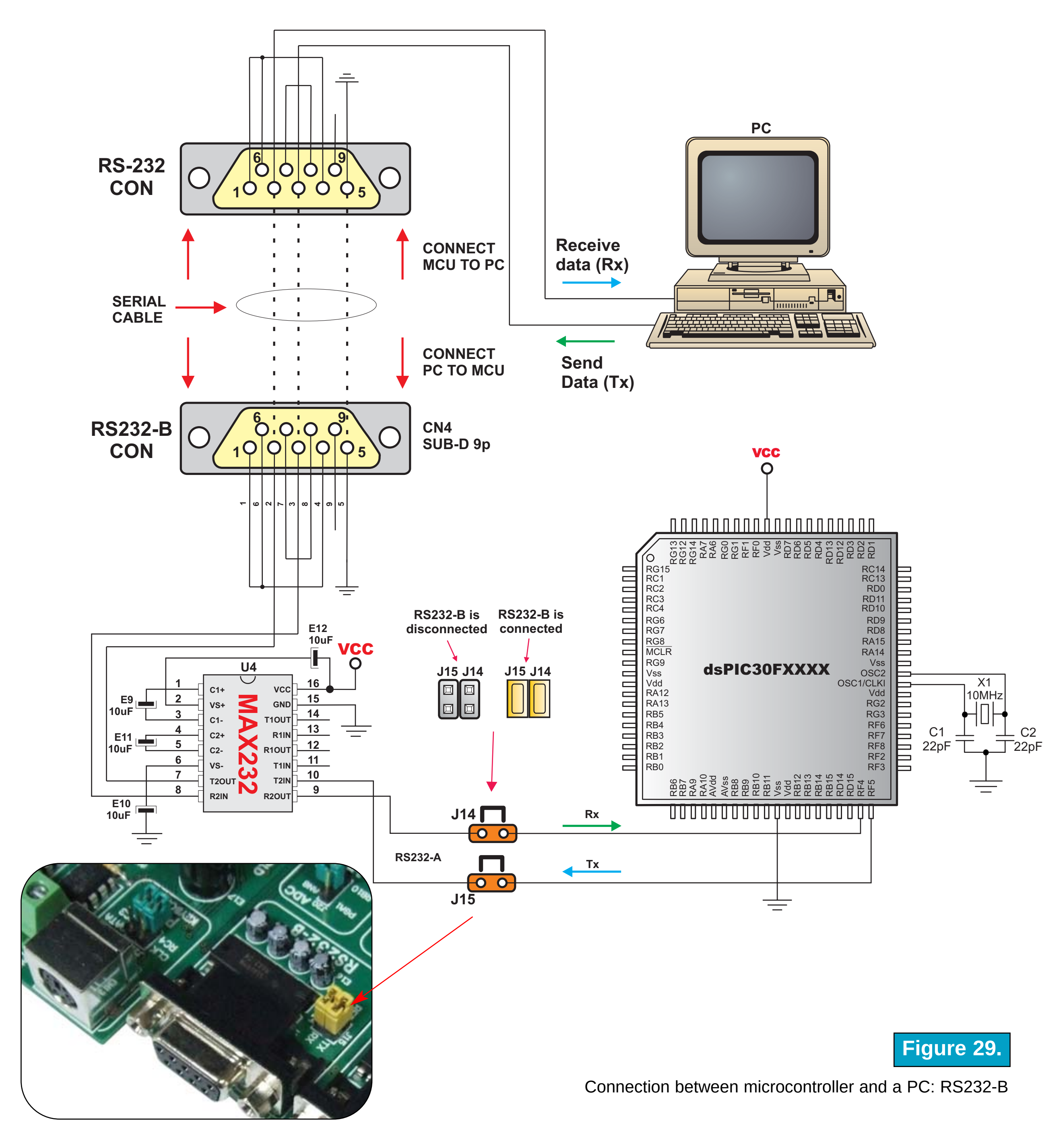


Figure 29.

Connection between microcontroller and a PC: RS232-B

PS/2 (KEYBOARD) CONNECTOR

PS/2 (KEYBOARD) CONNECTOR

Keyboards consist of a large matrix of keys, all of which are monitored by an on-board processor (called the "keyboard encoder".) The specific processor varies from keyboard-to-keyboard but they all basically do the same thing: Monitor which key(s) are being pressed/released and send the appropriate data to the MCU. This processor takes care of all the debouncing and buffers any data in its 16-byte buffer, if needed. All communication between the host and the keyboard uses an IBM protocol.

Please Note!!!

The pins to which a PS/2 keyboard is attached should be connected to pull-up resistors. Although PS/2 is a two-way communication bus, this library does not provide dsPIC-to-keyboard communication; e.g. the Caps Lock LED will not turn on if you press the Caps Lock key.

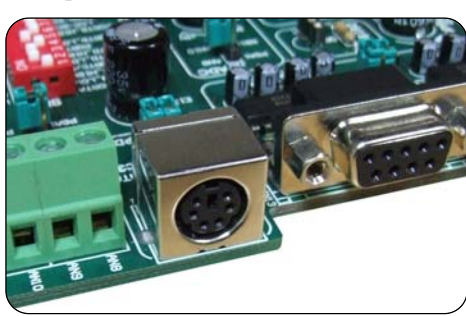


Figure 30. PS/2 connector

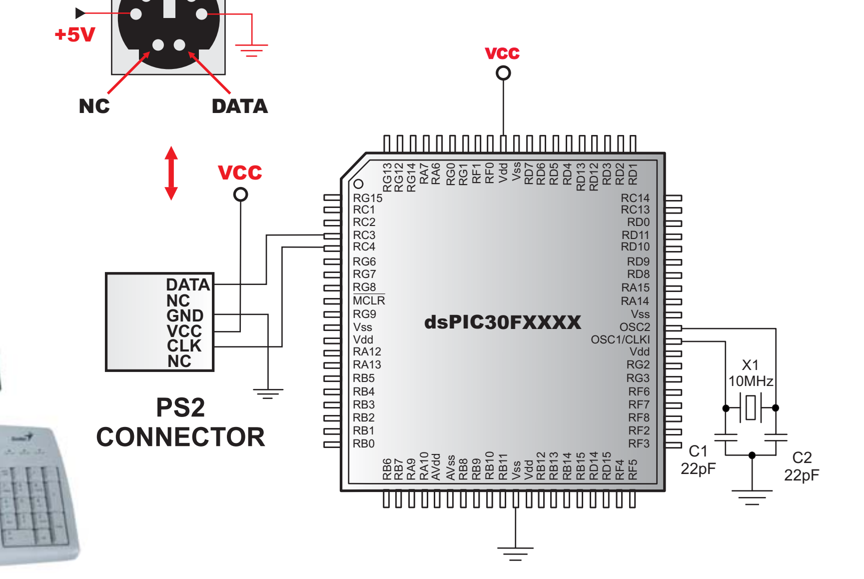


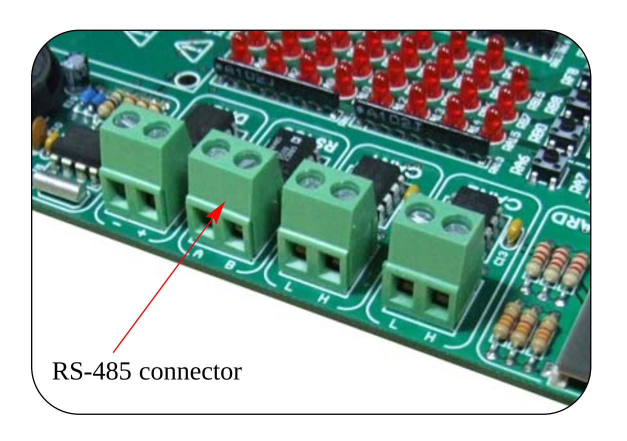
Figure 31. PS/2 keyboard and dsPICPRO2 layout

Figure 32. PS/2 schematic

RS-485 COMMUNICATION

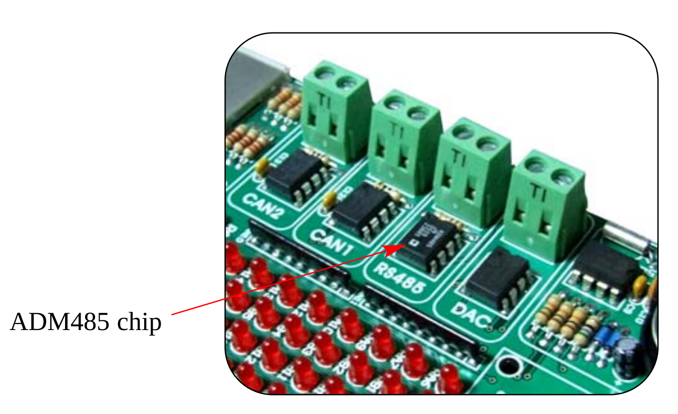
RS-485 communication enables point-to-point and point-to-multipoint data transfer. It is commonly used for data transfer between several microcontrollers. LTC485 interface tranciever is used for transforming signal from microcontroller's Rx and Tx lines to differential signal on A and B output lines.

Figure 33. RS-485 connector



dsPICPRO2 development board have one RS-485 communication device. In order to provide a more flexible system, the microcontroller is connected to the ADM485 through three switches on **SW4**. Switches 1, 2 and 3 are used to connect Rt, Tx and Rx lines from microcontroller to RS-485 port.

LTC485 and RS-485 connector **Figure 34.**



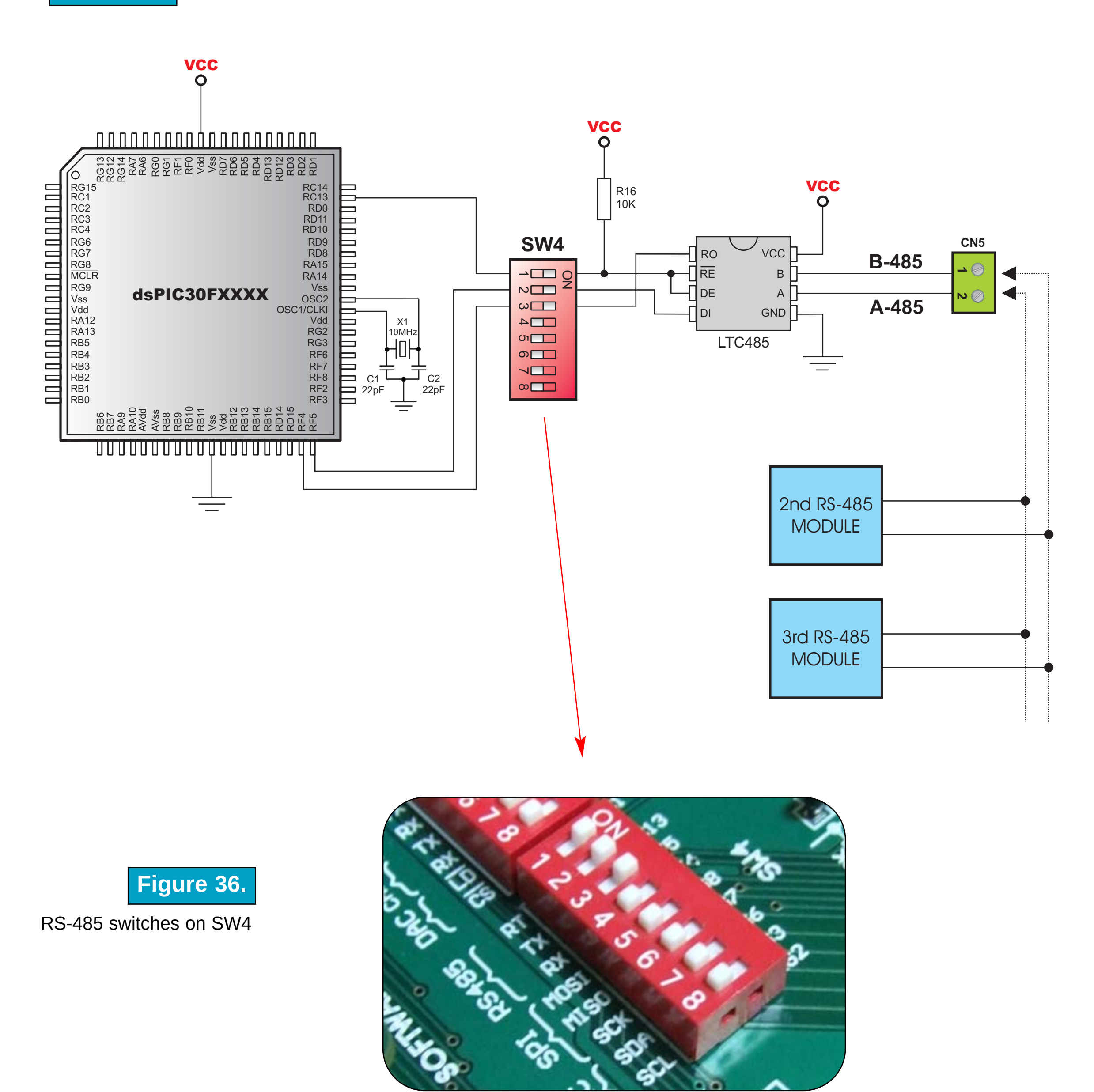


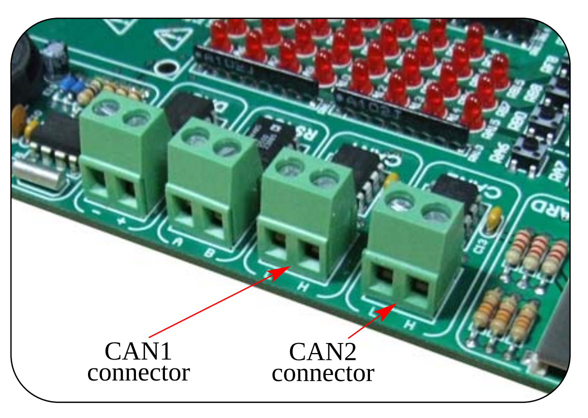
Figure 35. RS-485 schematic and connection to other RS-485 modules

Figure 36. RS-485 switches on SW4

CAN

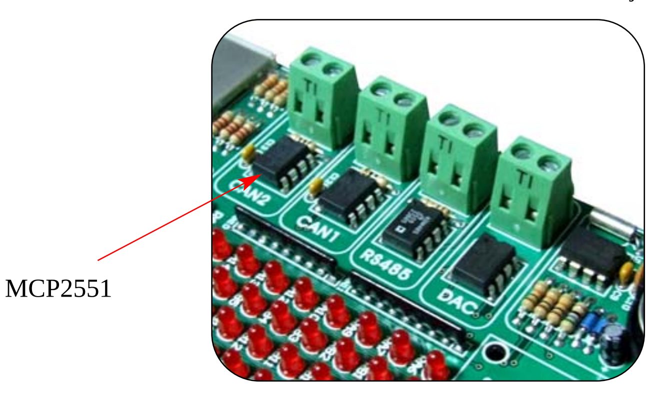
CAN (Controller Area Network) is a serial network that was originally designed for the automotive industry, but has also become a popular bus in industrial automation as well as other applications. CAN is the network established among microcontrollers. It is a two-wire, half-duplex, high-speed network system. Half-duplex means that microcontroller can send and receive data, but only one way at a time.

Figure 37. CAN connectors



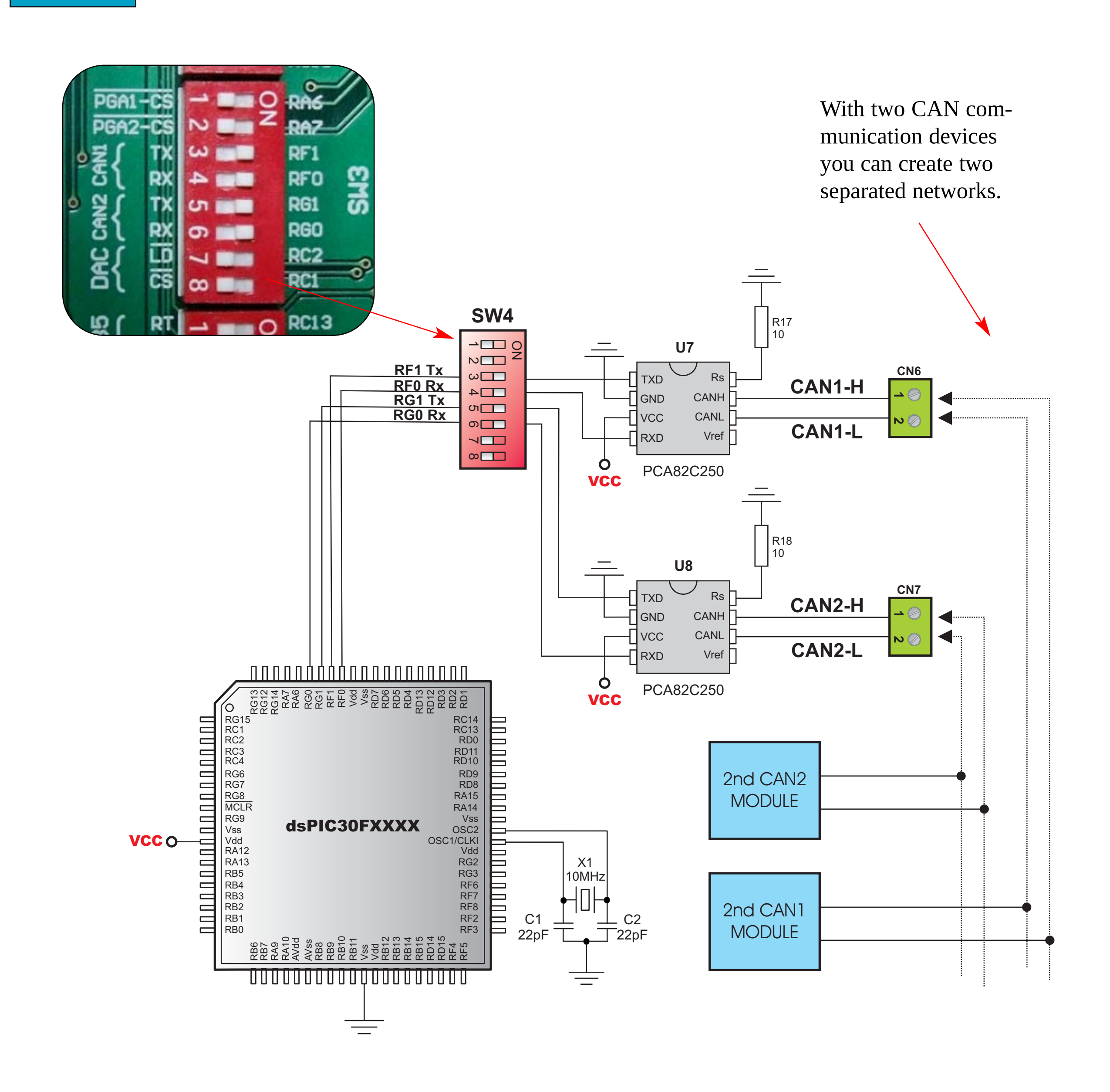
dsPICPRO2 development board have two CAN communication devices. In order to provide a more flexible system, the microcontroller is connected to the MCP2551 through the switches on **SW3.** Swiches 3 and 4 are used to connect Tx and Rx lines from microcontroller (pins RF1 and RF0) to CAN1. Swiches 5 and 6 are used to connect Tx and Rx lines from microcontroller (pins RG1 and RG0) to CAN2.

CAN connectors and jumpers **Figure 38.**



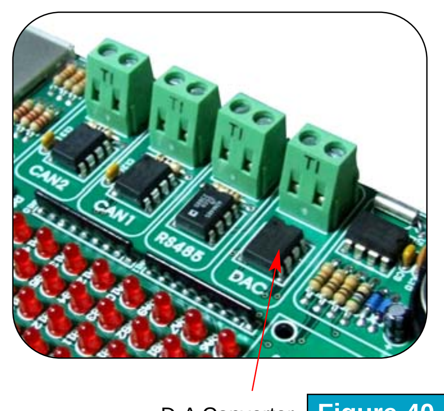
CAN

Figure 39. CAN schematic



D-A CONVERTER OUTPUT

DsPICPRO2 development board have DAC (Digital-to-Analogue Converter) that can simulate analogue output from 0-5V or from 0-4.096V depending of voltage reference. DAC-LD# and DAC-CS# pins must be connected from microcontroller to DAC, which is established by putting switches 7 and 8 on **SW3** in ON position. Also reference must be chosen by placing jumper J16 in desired position (reference voltage 5V or 4.096V). DAC use SPI communication so switches 4 and 6 on **SW4** must be enabled.



D-A Converter **Figure 40.**

Figure 41. D-A Converter

Vref line is connected
Vcc line is connected
All lines are disconnected

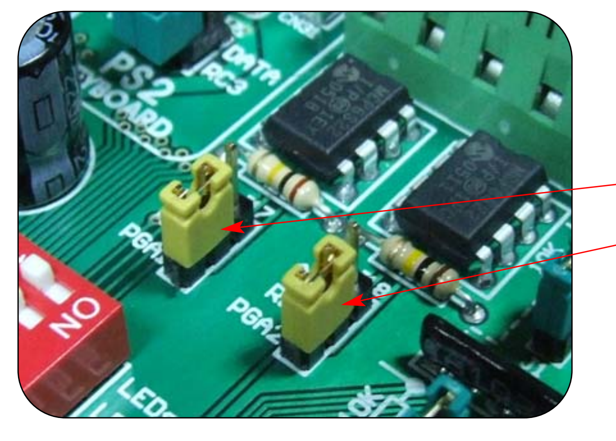
A-D CONVERTER INPUT

dsPICPRO2 development board have eight analogue signal inputs for working with ADC. Potentiometer P1 gives analogue signal to microcontroller's AN8 or AN10 analogue inputs. If the J20 jumper is in the upper position then the P1 is connected to AN8 input. AN8 input can be connected to microcontoller's RB8 pin directly (J17 upper position) or via Programmabile Gain Amplifier PGA1(J17 lower position).

If the J20 jumper is in the lower position then the P1 is connected to AN10 analogue input. AN10 is connected directly to microcontoller's RB10 pin. Potentiometer analogue output is in the range of 0V to 5V as drawn on the board.

Figure 42.

Jumpers J17 and J18, PGA1 and PGA2



J17

J18

Jumpers J17 and J18 for connecting AN8 and AN9 directly to microcontroller or through PGA1 and PGA2



Connectors for analogue input are placed on the upper-right side of development board. Inputs AN10 to AN15 are connected directly to microcontroller RB10 to RB15 pins. Inputs AN8 and AN9 are connected to microcontroller RB8 and RB9 pins through jumpers J17 and J18, respectively. If jumpers J17 and J18 are placed on the upper position, then AN8 and AN9 are connected directly to pins RB8 and RB9, but if placed to the lower position than AN8 and AN9 are connected to PGA (Programmabile Gain Amplifier).

Figure 43.

Potentiometer P1

Both PGA integrated circuits (MCP6S22) are connected to microcontroller through SPI communication and have CS signal (Chip Select). In order to work properly, SPI communication must be enabled by setting switches 4 and 6 on **SW4** in ON position (needs only SCK and MOSI because PGA only receives data from microcontroller - data about amount of gain that will be applied to input signal). Also, PGA-CS1 and PGA-CS2 must be enabled (switches 1 and 2 on **SW3**). In order to measure an analogue signal without interference, the pull-up/down jumper should be removed from PORTB high. In this way high pins of PORTB remain floating.

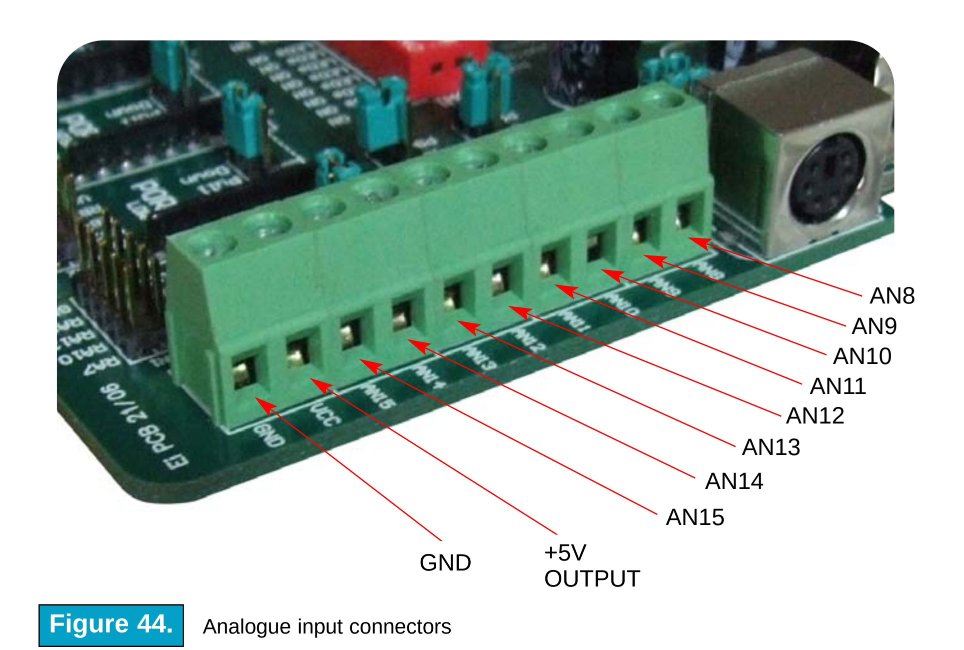


Figure 44. Analogue input connectors

Complete A-D Converter input schematic, along with PGA, is shown on the next page.

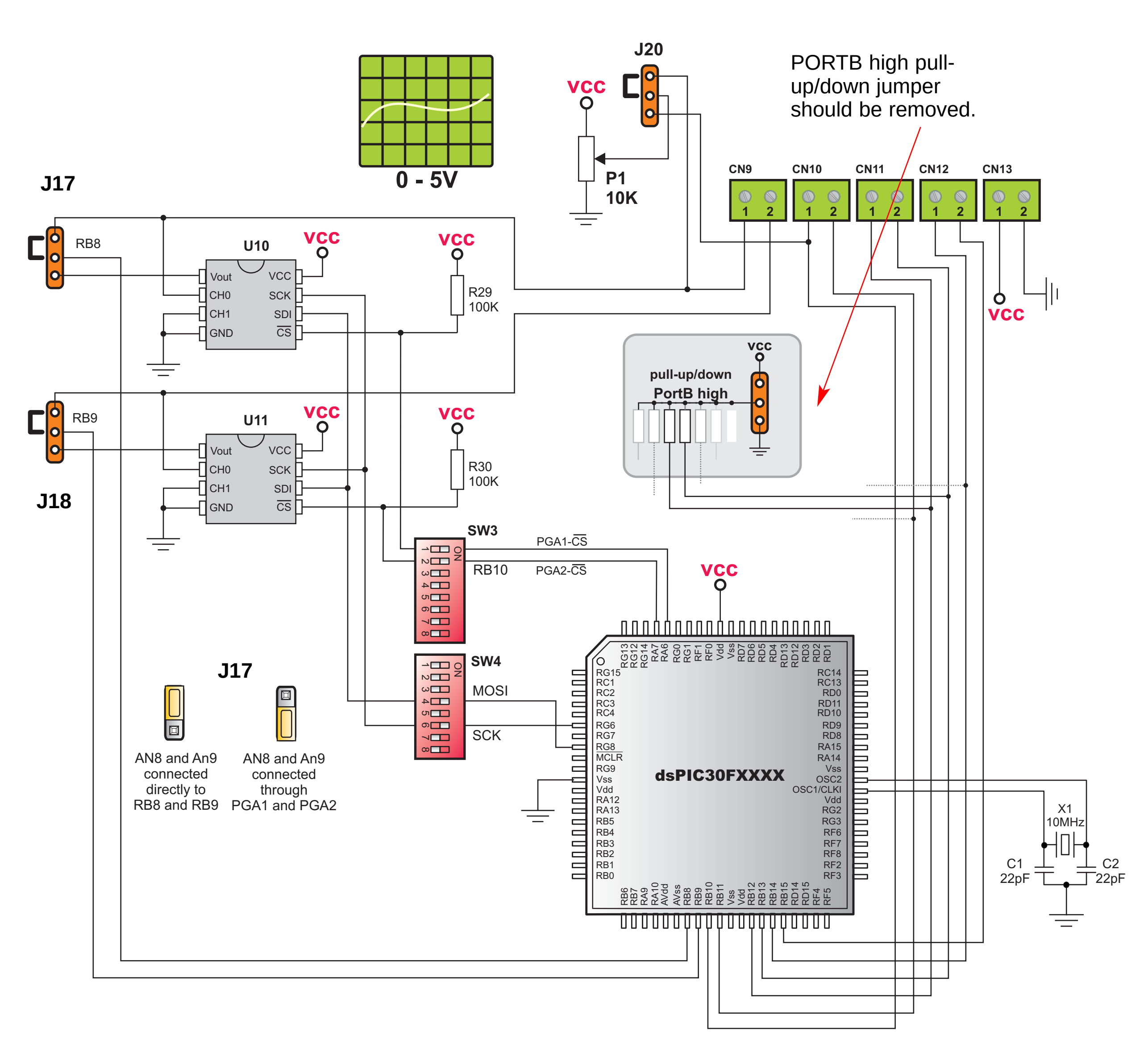


Figure 45. A-D Converter input schematic

DS1820 DIGITAL THERMOMETER

The DS1820 (alternatively DS18B20) digital thermometer is well suited to environmental temperature measurement, having a temperature range of -55C to 125C and an accuracy of +/-0.5C. It must be placed correctly in the 3-pin socket provided on the dsPICPRO2, with its rounded side to the bottom, as marked on the board. Otherwise the DS1820 could be permanently damaged. In order to work, DS1820 must be connected to microcontroller's RF6 pin, by enabling switch 3 on **SW2**.

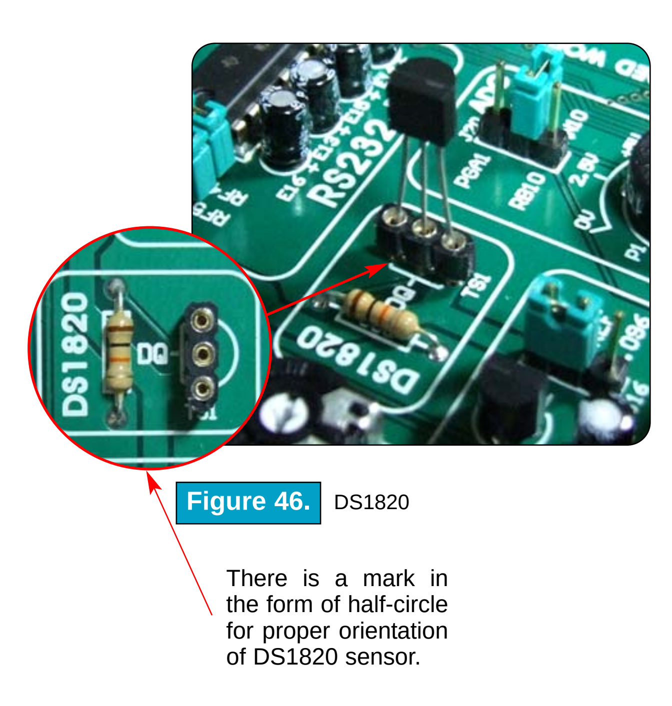


Figure 46. DS1820

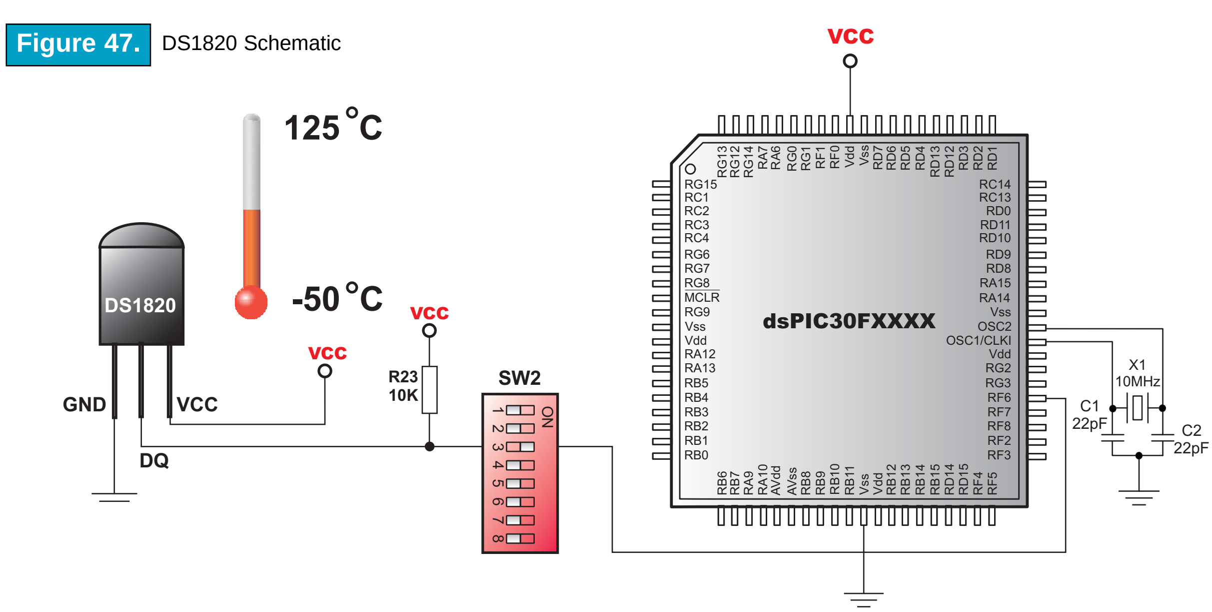


Figure 47. DS1820 Schematic

REAL TIME CLOCK (RTC)

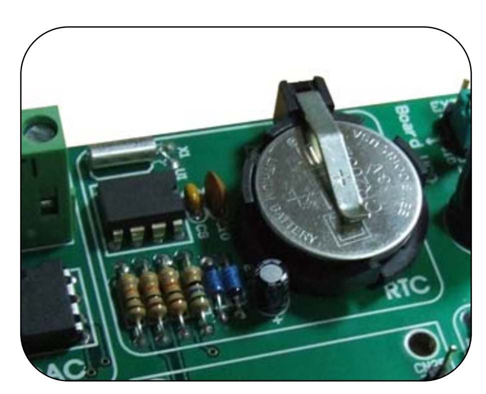


Figure 48. Real Time Clock

In many hardware projects there are needs for real time clock or delay source. Such devices as clocks, timers, etc. are impossible to product without knowledge of exact time. Real Time Clock on dsPICPRO2 development board is PCF8583P, and it use I2C serial communication to exchange informations with microcontroller. Also, it has one interrupt output. In order to work properly, both interrupt and I2C communication lines must be connected to microcontroller by placing switch 6 on **SW2**, and switches 7 and 8 on **SW4** in ON position.

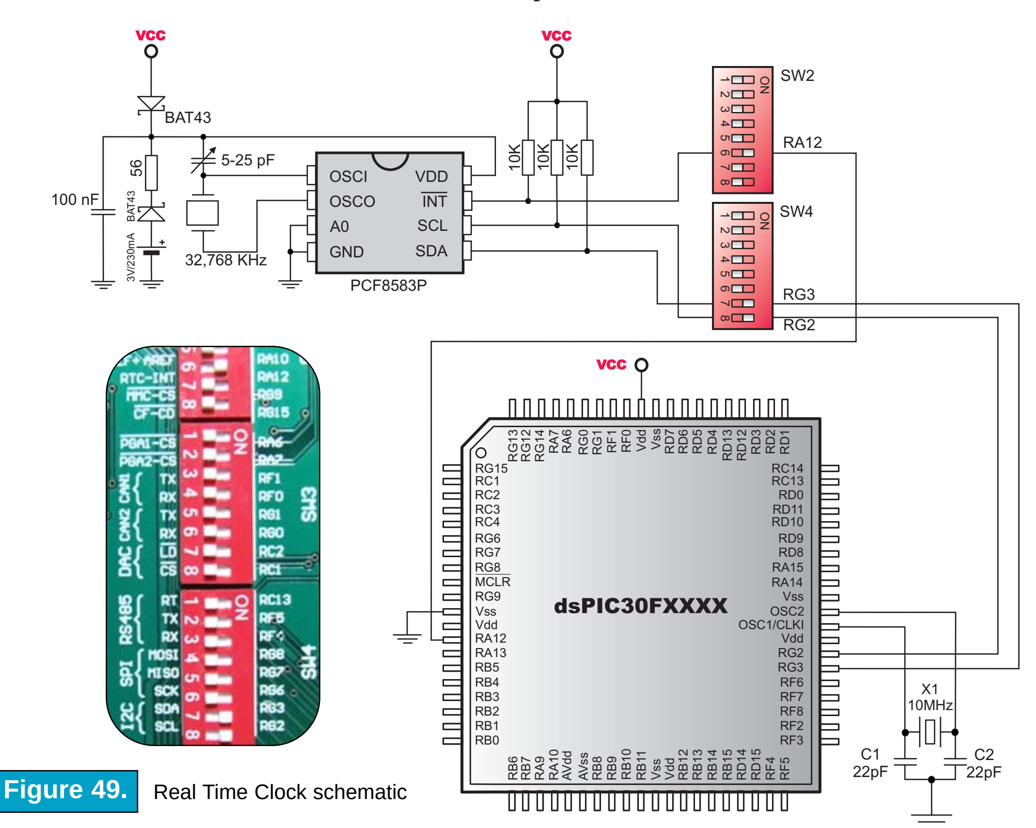


Figure 49. Real Time Clock schematic

COMPACT FLASH

Compact Flash is a small removable mass storage device. The application of Compact Flash include digital cameras, digital music players, desktop computers, handheld PCs, personal communicators, Palm PCs, Auto PCs etc. so you can easily exchange data from them and dsPICPRO2 development board. Compact Flash have non-volatile storage solution that does not require a battery to retain data indefinitely.

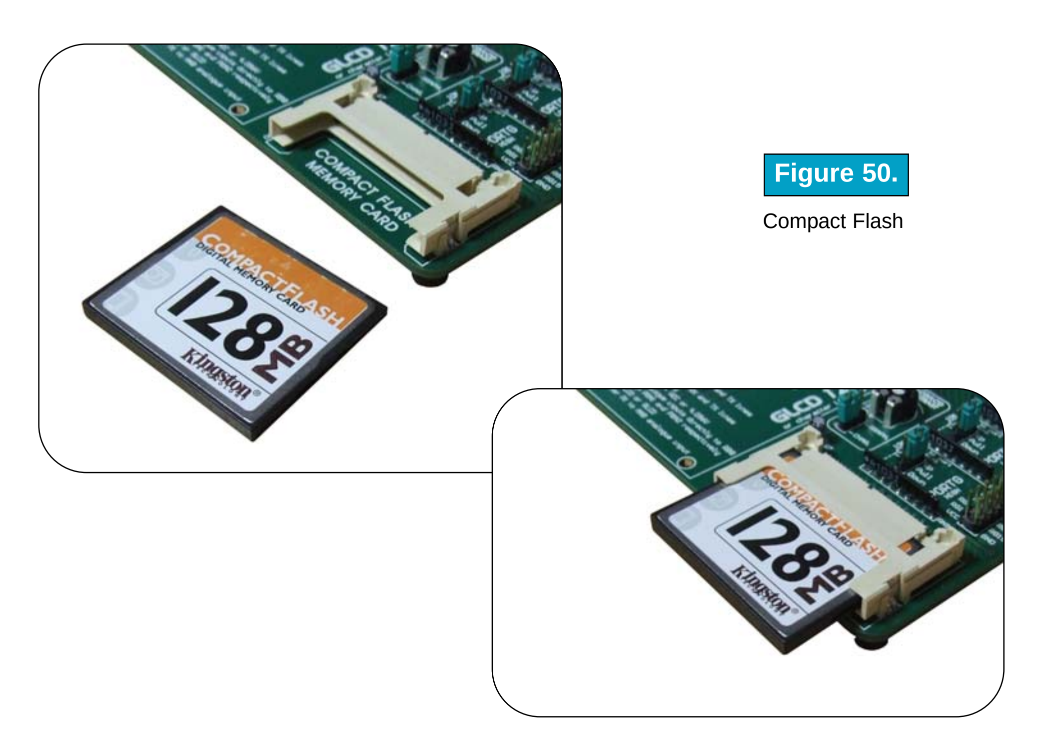


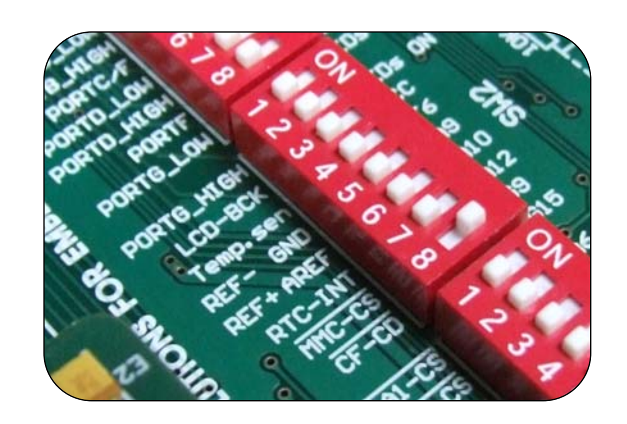
Figure 50.

Compact Flash

In order to detect when Compact Flash card is inserted, CFCD line is pulled high and it must be connected to microcontroller's pin RG15 by placing switch 8 on **SW2** in ON position. When Compact Flash card is inserted it drops CFCD level low and it can be detected by microcontroller. Compact Flash schematic is shown on Figure 51.

Figure 51.

Compact Flash schematic



MMC / SD (MULTIMEDIA CARD)

MMC card is used as storage media for a portable devices, in a form that can easily be removed for access by a PC. For example, a digital camera would use an MMC card for storing image files. With an MMC reader (typically small box that connects via USB or some other serial connection) you can easily transfer data from MMC card to your computer. Microcontroller on dsPICPRO2 communicates with Multi Media Card via SPI communication.

Modern computers, both laptops and desktops, often have SD slots, which can read MMC cards.

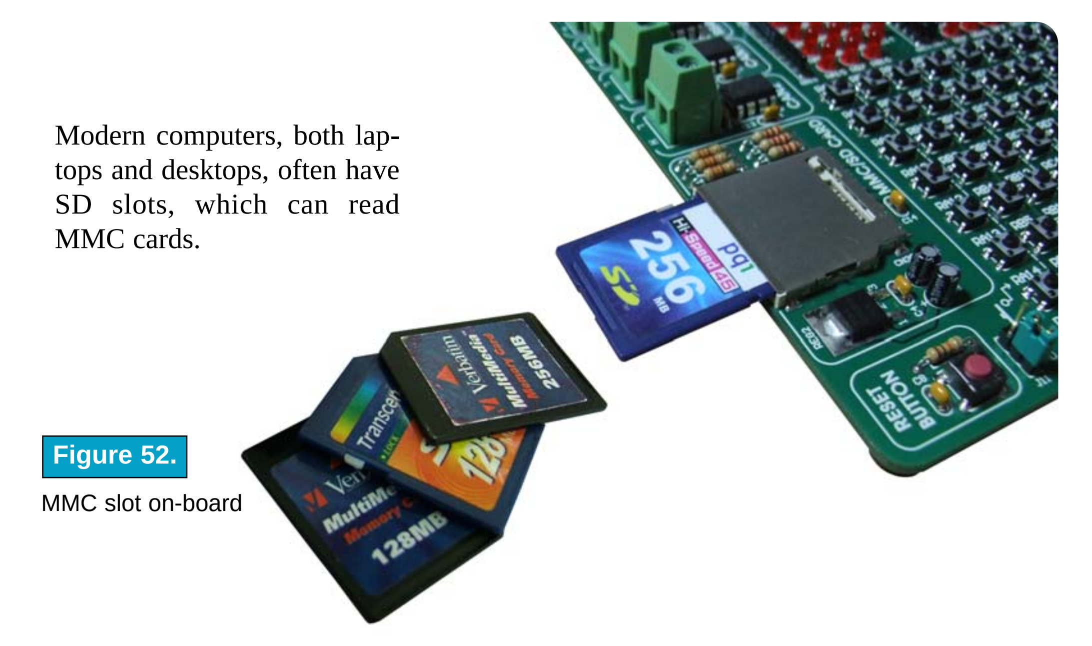


Figure 52.

MMC slot on-board

To enable MMC card you must turn on switch 7 on **SW2**. Also turn on switches 4, 5 and 6 on **SW4** to connect microcontrollers's SPI comunnication lines MOSI, MISO and SCK with MMC. Working voltage of dsPICPRO2 is 5V DC, while working voltage of MMC card is 3.3V DC. Because of that, there is a voltage regulator on-board with MMC card (MC33269DT-3.3). Data lines from microcontroller to MMC card must be also adjusted to 3.3V. It is done with resister voltage dividers as shown on Figure 53.

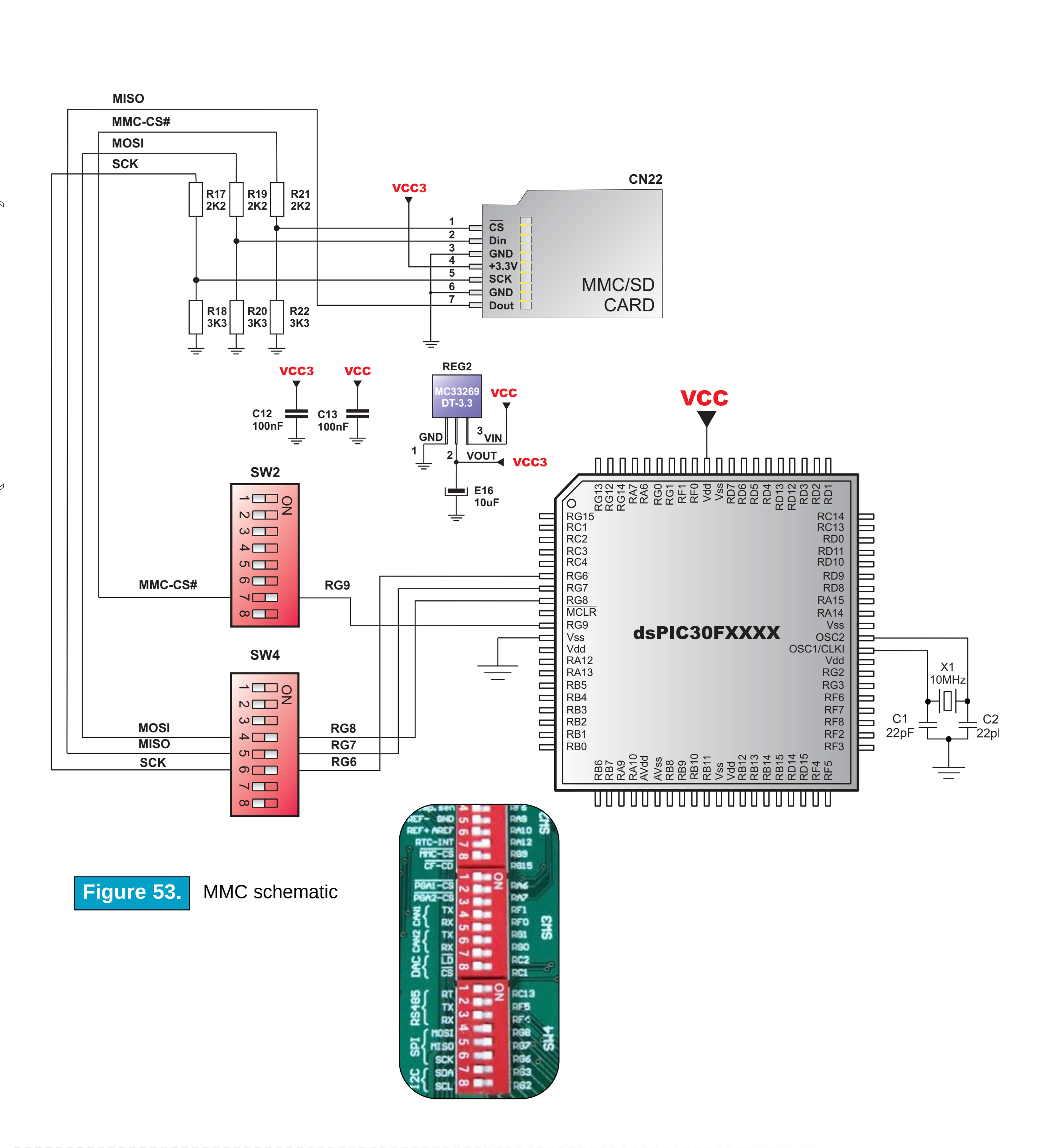


Figure 53. MMC schematic

DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via connectors placed along the right-hand side of the board. For each of the ports PORTA, PORTB low, PORTB high, PORTC, PORTD low, PORTD high, PORTF, PORTG low and PORTG high there is one 10-pin connector providing Vdd, GND and up to eight port pins.

These connectors can be used for system expansion with external boards such as Serial GLCD, IrDA, Ethernet, Toshiba GLCD etc. Ensure that the on-board peripherals are diconnected from microcontroller by setting the appropriate jumpers or switches, while external peripherals are using the same pins. The connectors can also be used for attaching logic probes or other test equipment.

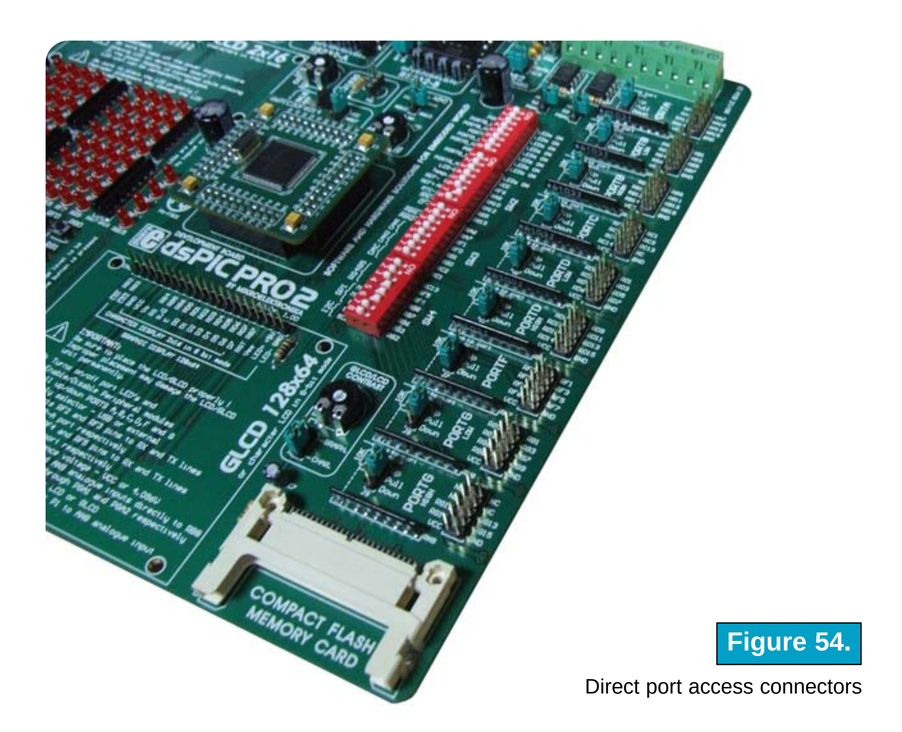
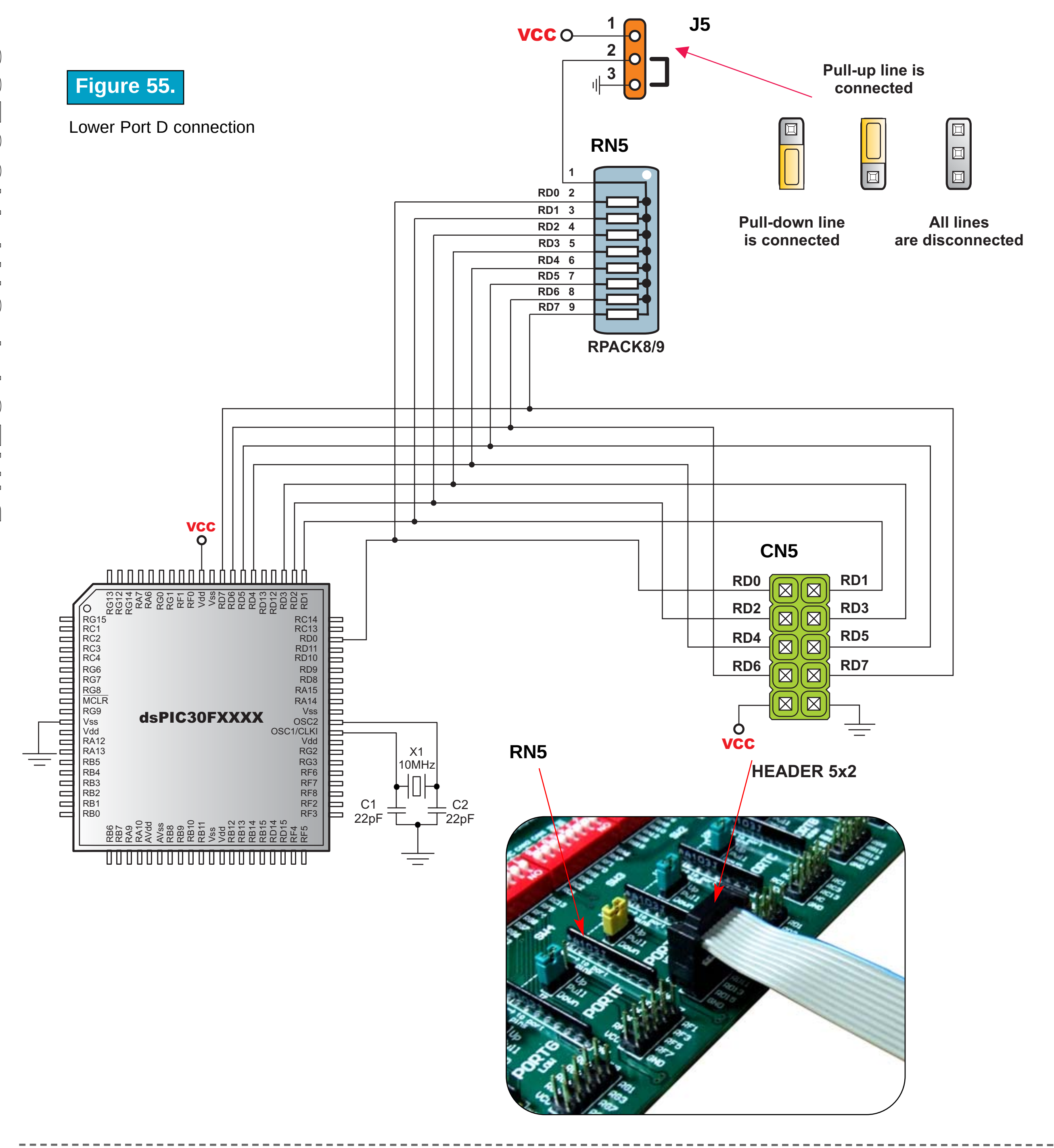


Figure 54.

Direct port access connectors

Figure 55.

Lower Port D connection



If you are experiencing problems with any of our products or you just want additional information, please let us know. We are committed to meet every your need.

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